Unit Seven: Chapter 8 ~ Chemical Equations and Reactions

Chemical Reactions

- A ____is the process by which one or more

  substances are ___________________________ into one or more different substances.

  - Creates ______________ substances with _________________________________ properties.

    - ____

- Also called a ____

Indicators of a Chemical Reaction

- ____:

  - ________________________________ (small amount of gas formed)

  - ________________________________ (more gas formed)

  - ________________________________ (large amount of gas formed)

- __________________________________:

  - ________________________________
  - ________________________________
  - ________________________________
  - ________________________________

- ______________________________:
    - ____________________
    - ____________________
    - ____________________
    - ____________________
- ____:
    - May ______________ to the bottom of liquids
    - May ______________ on top of liquids
        - Looks like a __________ material

Chemical Equations

- ____________________ form of a chemical reaction using:
    - ________________________________
        - For elements
    - ________________________________
        - For compounds
    - ___________________________
        - Number in ____________ of substances that tell ______________ are in the reaction

Chemical Equations

- ______________________________ → ______________________________
  - ________ → _________
- _______________________________________:
  - One or more substances (elements/compounds) that ________________ a reaction
- _______________________________________:
  - One or more _________________ substances (elements/compounds) ____ a reaction
- **Special symbols:**
  - ____________ means yields / forms / makes / produces
  - ____________ means plus / and / combined with
  - ____________ means solid
    - Or ____________ (crystalline)
  - ____________ means liquid
  - ____________ means gas
  - ____________ means aqueous solution
    - ____

- Terms written ______________ → means the item is needed for the

  ____

  -
  -
  -
  -
  -

Law of Conservation of Mass

- Chemical reactions must follow the law which states that __________________________

  ____.

- The ____ going into

  reactions (in reactants) ________________ come out of reaction (in products).

- Mass of the reactants ______________________ the mass of the products.

- This is why ___________ chemical reactions ____________________________________.

Example Problems

- Ex. 1: $Ag_2O(s) \rightarrow Ag(s) + O_2(g)$

- Ex. 2: $Al(s) + NiSO_4(s) \rightarrow Ni(s) + Al_2(SO_4)_3(s)$

- Ex. 3: Magnesium metal plus hydrochloric acid yields hydrogen gas and magnesium chloride.

- Ex. 4: Sodium metal and water react to form aqueous sodium hydroxide and hydrogen gas.

- Ex. 5: Calcium metal plus iodine react to produce calcium iodide.

- Ex. 6: $C_3H_8(g) + O_2(g) \rightarrow CO_2(g) + H_2O(l)$

- Ex. 7: Aqueous magnesium nitrate reacts with aqueous potassium hydroxide to form solid magnesium hydroxide and aqueous potassium nitrate.

****From UNIT 6: Extra Practice Naming and Writing Compounds:**

- **Dr. Alan's Chemistry Site: http://chemistry.alanearhart.org/Quizzes/Nomenclature/**
  - He offers quizzes with TONS of practice problems. In the drop down section, select from Binary Molecular Compounds, Binary Ionic Compounds, and/or Polyatomic Ionic Compounds!

Extra Practice Balancing Chemical Equations:

- **Dr. Alan's Chemistry Site: http://chemistry.alanearhart.org/Quizzes/Stoichiometry/**
  - He offers quizzes with TONS of practice problems. In the drop down section at the bottom of the page, select Balancing Chemical Equations. I'd suggest writing these problems on loose-leaf and keeping them in your homework binder so I can help you if you had any trouble with them.

Types of Chemical Reactions

- So many chemical reactions can occur or are occurring that it would be ______________________________ to predict their products if it was not possible to place many of them into ____________________________.

- Based on the ____ in reactions.

Synthesis Reactions

- _______________________ substances (_______________) combine to form

  ______________________________ (_______________).

- General Equation:
  - _________________________
    - A and B can be ______________________________.
    - AB is a _____________________.

- Example: 2 Mg(s) + O_2(g) → 2 MgO(s)

Decomposition Reactions

- A ______________________________ (_______________) undergoes a reaction

  that produces______________________ simpler substances (________________).

- ____________________ of synthesis reactions.

- Most decomposition reactions take place only when _______________ in the form

  of ____.

  - The decomposition of a substance by an ___________________________is

    called ____________________.

- General Equation:
    - ___________________________________
        - AB is a _________________________________.
        - A and B can be ____.
- Example:
    - $2\ H_2O\ (l) \xrightarrow{\text{electricity}} 2\ H_2(g) + O_2(g)$

Single Replacement Reactions

- Also known as ____.
- ___________________________ replaces a similar __________________ in a __________________ (___________________) to form a ____ (___________________).
    - Many take place in _________________________ solution.
    - Amount of _________________________________ than in synthesis and decomposition reactions.

- General equation:
    - ____
        - Positive oxidation (metal) ___________________ positive oxidation (metal).
    - A and B are __________________________.
    - BC and AC are ___________________________.
- Example: $Mg(s) + 2\ HCl(aq) \rightarrow H_2(g) + MgCl_2(aq)$
- General equation:
    - ____
        - Negative oxidation (nonmetal) ___________________ negative oxidation (nonmetal).
    - A and C are __________________________.
    - BC and BA are ___________________________.
- Example: $Cl_2(g) + 2\ KBr(aq) \rightarrow 2\ KCl(aq) + Br_2(l)$

Double Replacement Reactions

- Or ____.
- The __________ of two ____________________ (___________________) exchange places in _______________ solution to form two new ___________________ (_____________________).
    - One of the _____________________________________formed is usually:
        - A ____
        - An insoluble _____________ that _______________ out of the solution
        - Or a _________________________________, usually _______________
    - The other compound is often ___________________ and remains ________________ in the solution.
- General Equation:
    - ______________________________________
    - All are ____________________.
- Example: $2\ KI(aq) + Pb(NO_3)_2(aq) \rightarrow PbI_2(s) + 2\ KNO_3(aq)$

Combustion Reactions

- A substance (usually a ____) combines with

  ___________________, releasing a large amount of ___________________ in the form of

  ___________________ and ___________________.

- The products are ______________________________ and _____________________.

- General Equation:
  - ____

- Example: $CH_4(g) + 2\ O_2(g) \rightarrow CO_2(g) + 2\ H_2O(l)$

- ***Balancing Tip:*** For combustion reactions, if there is no oxygen in the hydrocarbon reactant, an odd number coefficient cannot proceed water in the products. Take the odd number that would be necessary and **double** it, then balance the rest of the equation from there.

Abbreviations

- Synthesis (_________)

- Decomposition (_________)

- Single replacement/displacement (_________ or _________)

- Double replacement/displacement (_________ or _________)

- Combustion (_________)

Activity Series

- The ability of an element to _____________ is referred to as the element's _____________.
    - The more _______________ an element reacts with other substances, the ________________ its activity is.
- Activity series can be defined as ____ ____ ____.
    - This is based on their ____________________.
    - For metals, greater activity means a greater ease of_______________ of electrons. This forms ____.
    - For nonmetals, greater activity means a greater ease of ________________ of electrons. This forms ____.
- The activity series is usually determined by ____ reactions.
- In the activity series, the most active element is placed at the _________________ and can replace each of the elements ________________ it from a compound in a ____ reaction.

- An element farther down in the activity series can replace any element

  ____________________ it but not any _____________________ it.

- Activity series are used to help ____

  ____.

- Examples:
  - $2Al(s) + 3ZnCl_2(aq) \rightarrow 3Zn(s) + 2AlCl_3(aq)$
    - According to the activity series, Al is located _________________ Zn and is

      therefore ________________ to replace Zn in a compound.
  - $Co(s) + 2NaCl(aq) \rightarrow$ no reaction
    - According to the activity series, Co is located _______________ Na and is

      therefore ______________________ to replace Na in a compound so the

      reaction ____________________________.

- It is important to remember that like many other aids used to predict the products

  of chemical reactions, activity series are based on ___________________________________.

Chapter 9 ~ Stoichiometry

Recipes

- What does a recipe tell you?
  - The _______________ amount of ___________________ to use in order to obtain a __________________ amount of __________________.

Recipes & Balanced Equations

- A ________________ chemical equation tells you what amounts of _________________ to mix and what amounts of ___________________ to _______________.
  - Chemists use balanced equations as a _________________________________ how much _________________ is needed or ______________ is formed in a reaction.
    - When you know the quantity of _________ substance in a reaction, you can calculate the quantity of ___________________ substance __________________ or ___________________ in the reaction!
      - Quantity can be measured in terms of _____________________ ___________________, _____________, ___________________, or _____________.

What is Stoichiometry?

- ____________________________ is the calculation of the quantities of ______________________ and ______________________ involved in a chemical reaction.
  - ____:
    - 1. ____
    - 2. ____
      - ______ mole = ______________________
      - ______ mole = ____
      - _____________________________

Mole-Mole Ratio

- The ______________________ is a conversion factor derived from the ___________________ of a ______________________ chemical equation.
  - Used to ____________________between moles of ____________________________________, between moles of ___________________, or between moles of ______________________.
- Example: $N_2 + 3H_2 \rightarrow 2NH_3$

Solving Stoichiometry Problems

- Check to make sure the equation is _________________________.
- 1. ______________________ the given quantity (usually _________________) to moles.
- 2. ______________________ the mole-mole ratio.
- 3. ______________________ to the desired units (usually _________________).
- HINTS ☺:
  - If you start with ____________, you do not need step #______.
  - If you need to end with ____________,, you do not need step #______.
  - You **ALWAYS** need step #_____.

Example Problems!

- How many moles of sodium bromide will be produced when ___________mol of bromine reacts with sodium iodide to form sodium bromide and iodine?

- Suppose __________ g of aluminum reacts with sulfur to produce aluminum sulfide. How many moles of sulfur will be needed in this reaction?

- Nitrogen can react with hydrogen to produce ammonia (NH_3). How many grams of nitrogen will be needed to produce _________ mol of ammonia?

- In a reaction between carbon and oxygen, ___________ g of carbon dioxide is formed. How many grams of carbon were burned?

Extra Practice with Stoichiometry:

- **Dr. Alan's Chemistry Site:** **http://chemistry.alanearhart.org/Quizzes/Stoichiometry/**
  - He offers quizzes with TONS of practice problems. In the drop down section at the bottom of the page, select Stoichiometry. Check the box to limit the molar masses to one decimal place. (**NOTE:** Your answers may not match up exactly with his due to rounding since we take the molar masses out to two decimal places). I'd suggest writing these problems on loose-leaf and keeping them in your homework binder so I can help you if you had any trouble with them.

Reinforcement Problems!

- 1. One reaction that produces hydrogen gas can be represented by the following **unbalanced** chemical equation. What mass of HCl is consumed by the reaction of ______________ mol of magnesium?

$$Mg(s) \quad + \quad HCl(aq) \quad \rightarrow \quad MgCl_2(aq) \quad + \quad H_2(g)$$

- 2. Acetylene gas (C_2H_2) is produced as a result of the following **balanced** reaction.

$$CaC_2(s) \quad + \quad 2H_2O(l) \quad \rightarrow \quad C_2H_2(g) \quad + \quad Ca(OH)_2(aq)$$

  If ______________ g of CaC_2 are consumed in this reaction, how many moles of H_2O are needed?

- 3. When sodium chloride reacts with silver nitrate, silver chloride precipitates. The other product is sodium nitrate. What mass of AgCl is produced from ______________ g of $AgNO_3$?

- 4. Copper reacts with silver nitrate through single replacement. If _______________ g of silver are produced from the reaction, how many moles of copper (II) nitrate are also produced?

- 5. Iron is generally produced from iron ore through the following **unbalanced** reaction in a blast furnace.

$$Fe_2O_3(s) \quad + \quad CO(g) \quad \rightarrow \quad Fe(s) \quad + \quad CO_2(g)$$

If _______________ kg of Fe_2O_3 are available to react, how many moles of CO are needed?

- 6. Aspirin, $C_9H_8O_4$, is produced through the following **balanced** reaction of salicylic acid, $C_7H_6O_3$, and acetic anhydride, $C_4H_6O_3$:

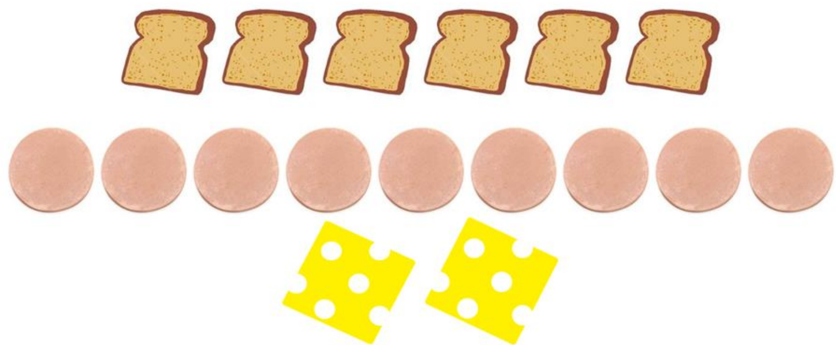
$$C_7H_6O_3(s) \quad + \quad C_4H_6O_3(l) \quad \rightarrow \quad C_9H_8O_4(s) \quad + \quad HC_2H_3O_2(l)$$

What mass of aspirin (in kg) could be produced from _______________ mol of salicylic acid?

Limiting Reactants

Warm-Up

- You find 6 slices of bread, 9 pieces of meat, and 2 pieces of cheese in your kitchen.



  - Each sandwich must have 2 pieces of bread, 3 pieces of meat, and 1 piece of cheese.

- How many sandwiches can you make with the ingredients you found in your kitchen?
- What ingredient limits the amount of sandwiches you can make?
- How many ingredients do you have left over?

Limiting and Excess Reactants

- ______________________: the reactant that determines the __________ of product that can be __________ by a chemical reaction
  - The ____________________ is _____________ used up in a chemical reaction.

- ________________________________: the reactant that is ____________________________

  ________________________ in a chemical reaction

Example Problems!

- 1. Some rocket engines use a mixture of hydrazine, N_2H_4, and hydrogen peroxide, H_2O_2, as the propellant. The reaction is given by the following **balanced** equation:

$$N_2H_4(l) \quad + \quad 2H_2O_2(l) \quad \rightarrow \quad N_2(g) \quad + \quad 4H_2O(g)$$

  - Which is the limiting reactant in this reaction when ___________ mol of N_2H_4 is mixed with __________ mol H_2O_2?

  - How much of the excess reactant, in moles, remains unchanged?

- 2. In a reaction chamber, __________ mol of aluminum is mixed with ________ mol of chlorine gas to produce aluminum chloride.
    - Determine the balanced equation.
    - What is the limiting reactant? What is the excess reactant? Label them in the balanced equation.
    - How much of the excess reactant is left over, in moles, after the reaction goes to completion?
    - What is the amount, in moles, of aluminum chloride produced?

- 3. _______________ g of gold (III) sulfide reacts with ___________ g of hydrogen gas to produce elemental gold and hydrogen sulfide.
    - Determine the balanced equation.
    - What is the limiting reactant? What is the excess reactant? Label them in the balanced equation.
    - How much of the excess reactant, in grams, is left over after the reaction goes to completion?
    - What is the amount, in grams, of elemental gold produced?

- 4. When C_3H_8 burns in oxygen, CO_2 and H_2O are produced. If _________ g of C_3H_8 reacts with __________ g of O_2, how much CO_2 is produced?
    - Determine the balanced equation.
    - What is the limiting reactant? What is the excess reactant? Label them in the balanced equation.
    - How much of the excess reactant, in grams, is left over after the reaction goes to completion?
    - What is the amount, in grams, of carbon dioxide produced?

Percent Yield

Theoretical Yield

- The ______________________ amount of product that can be ______________________ from a given amount of reactant.
    - The value that has been _______________________ using a stoichiometry problem.

Actual Yield

- The ________________________ amount of a product obtained from a chemical reaction.

Percent Yield

- The ___________________ and ________________ yields are used to calculate the _________________________.
- ______________________________ is the ratio of the _______________ yield to the ___________________ yield, multiplied by _________.

Example Problems:

- 1. Methanol (CH_3OH) can be produced through the reaction of carbon monoxide and hydrogen gas in the presence of a catalyst. If __________ g of CO reacts to produce __________g CH_3OH, what is the percent yield of CH_3OH?

- 2. Quicklime, CaO, can be prepared by roasting limestone, $CaCO_3$, according to the chemical equation below. When ________________ g of $CaCO_3$ are heated, the actual yield of CaO is ______________ g. What is the percentage yield?

$$CaCO_3 \rightarrow CaO + CO_2$$

- 3. For the **unbalanced** equation shown below, if the reaction of _______________ g of O_2 produces __________ g of H_2O, what is the percent yield?

$$C_2H_4O \quad + \quad O_2 \quad \rightarrow \quad CO_2 \quad + \quad H_2O$$

- 4. Mg + HNO_3 → $Mg(NO_3)_2$ + H_2

- If I start this reaction with __________ g of magnesium and an excess of nitric acid, how many grams of hydrogen gas should I be able to produce? If ________ g of hydrogen was actually produced, what was my percent yield of hydrogen?

Exam Date: ____

- **Chemical Equations & Reactions (Chapter 8)**
  - ✓ chemical reaction / indicators of reaction
  - ✓ Law of Conservation of Mass
  - ✓ balancing equations (coefficients / special symbols)
  - ✓ types of reactions
  - ✓ activity series
- **Stoichiometry (Chapter 9)**
  - ✓ mole ratio / molar mass / balanced equations for chemical reactions
  - ✓ solve for amount of R or P in moles or mass
  - ✓ limiting reactants
  - ✓ % yield / theoretical yield / actual yield