GET DETAILS FROM FLIPCHART!!!!!!!!!!

Holt Modern Chemistry Review

CHAPTER 8: CHEMICAL EQUATIONS AND REACTIONS

The following pages contain the bulk (but not all) of the information for the chapter 8 test.
Focus on this content, but make sure to review class notes, activities, handouts, questions, etc.
If you study this document and NOTHING else, you should at least be able to PASS the test.
******** Test items will be recall, examples, and/or application of this content. ********

OUTCOMES

- Collaborate with peer(s) to understand chemistry content (C C)
- Communicate chemistry content to teacher and peer(s) (E C)
- 8.1: Write word and formula equations (T & R)
- 8.1: Balance chemical equations (F & PK)
- 8.1: Follow the Law of Conservation of Mass (F & PK)
- 8.2: Classify types of reactions – synthesis, decomposition, single displacement, double displacement, combustion (T & R)

8.1: DESCRIBING CHEMICAL REACTIONS

- ***Vocabulary***
  - **chemical equation** -- a representation of a chemical reaction that uses symbols to show the relationship between the reactants and the products
  - **precipitate** -- a solid that is produced as a result of a chemical reaction in solution
  - **coefficient** -- a whole number that appears as a factor in front of a formula in a chemical equation
  - **word equation** -- an equation in which the reactants and products in a chemical reaction are represented by words
  - **formula equation** -- a representation of the reactants and products of a chemical reaction by their symbols or formulas
  - **reversible reaction** -- a chemical reaction in which the products re-form the original reactants
- ***Chapter Highlights***
  - A *chemical reaction* is the process by which one or more substances are changed into one or more different substances.
  - Four observations that suggest a chemical reaction is taking place are the evolution of energy as heat and light, the production of gas, a change in color, and the formation of a precipitate.
    - A solid that is produced as a result of a chemical reaction in solution and that separates from the solution is known as a **precipitate.**
  - Chemical equations use symbols and chemical formulas to represent a chemical reaction.
    - In any chemical reaction, the original substances are known as the *reactants* and the resulting substances are known as the *products*.
    - Reactants are written on the left and products on the right.
    - Reactants are consumed or used; products are produced.
  - The following requirements will aid you in writing and reading chemical equations correctly.
    - The equation must represent known facts. *(word equation)*
    - The equation must contain the correct formulas for the reactants and products. *(formula equation)*
    - The law of conservation of mass must be satisfied *(balanced)*
  - A **word equation** is an equation in which the reactants and products in a chemical reaction are represented by words.
    - Example: methane + oxygen → carbon dioxide + water
  - The next step in writing a correct chemical equation is to replace the names of the reactants and products with appropriate symbols and formulas.
    - A **formula equation** represents the reactants and products of a chemical reaction by their symbols or formulas.
    - Example: The formula equation for the reaction of methane and oxygen is $CH_4(g) + O_2(g) \rightarrow CO_2(g) + H_2O(g)$ *(not balanced)*
  - To complete the process of writing a correct equation, the law of conservation of mass must be taken into account.
    - According to the **law of conservation of mass**, the total mass of reactants must equal the total mass of products for any given chemical reaction.
    - A ***balanced*** chemical equation represents, with symbols and formulas, the identities and relative amounts of reactants and products in a chemical reaction.
    - The relative amounts of reactants and products represented in the equation must be adjusted so that the numbers and types of atoms are the same on both sides of the equation. ***(DO NOT change subscripts!!!!)***
    - This process is called *balancing an equation* and is carried out by inserting **coefficients**.

- Balanced chemical equations show that the elements, atoms and mass on the left equals the elements, atoms and mass on the right: the matter that goes in must come out.
  - Example: The following chemical equation shows that ammonium dichromate breaks down into nitrogen, chromium(III) oxide, and water. $(NH_4)_2Cr_2O_7(s) \rightarrow N_2(g) + Cr_2O_3(s) + 4H_2O(g)$
- To balance the equation, begin by counting atoms of elements that are combined with atoms of other elements and that appear only once on each side of the equation. $CH_4(g) + O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$
- Steps to balancing a chemical reaction:
  - Balance the different types of atoms one at a time.
  - First balance the atoms of elements that are combined and that appear only once on each side of the equation.
  - Balance polyatomic ions that appear on both sides of the equation as single units.
  - Balance H atoms and O atoms after atoms of all other elements have been balanced.

- **EXAMPLE: Word Equation, Formula Equation, and Balanced Formula Equation**

Write word and formula equations for the chemical reaction that occurs when solid sodium oxide is added to water at room temperature and forms sodium hydroxide (dissolved in the water). Include symbols for physical states in the formula equation. Then balance the formula equation to give a balanced chemical equation.

SOLUTION

The word equation must show the reactants, sodium oxide and water, to the left of the arrow. The product, sodium hydroxide, must appear to the right of the arrow.

sodium oxide + water ⟶ sodium hydroxide

The word equation is converted to a formula equation by replacing the name of each compound with the appropriate chemical formula. To do this requires knowing that sodium has an oxidation state of +1, that oxygen usually has an oxidation state of −2, and that a hydroxide ion has a charge of 1−.

$Na_2O + H_2O \longrightarrow NaOH$ (not balanced)

Adding symbols for the physical states of the reactants and products and the coefficient 2 in front of NaOH produces a balanced chemical equation.

$Na_2O(s) + H_2O(l) \longrightarrow 2NaOH(aq)$

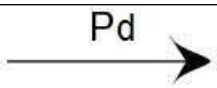
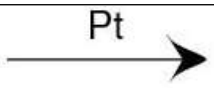
DIATOMIC MOLECULES	
Br I N Cl H O F / "magic 7"	Br_2 I_2 N_2 Cl_2 H_2 O_2 F_2

8.2: TYPES OF CHEMICAL REACTIONS

- ***Vocabulary***
  - **synthesis reaction** -- a reaction in which two or more substances combine to form a new compound
  - **decomposition reaction** -- a reaction in which a single compound breaks down to form two or more simpler substances
  - **electrolysis** -- the process in which an electric current is used to produce a chemical reaction, such as the decomposition of water
  - **single-displacement reaction** -- a reaction in which one element or radical takes the place of another element or radical in a compound
  - **double-displacement reaction** -- a reaction in which a gas, a solid precipitate, or a molecular compound forms from the apparent exchange of atoms or ions between two compounds
  - **combustion reaction** -- the oxidation reaction of an element or compound, in which energy as heat is released
- ***Chapter Highlights***
  - The 4 simplest types of chemical reactions are synthesis (*marriage*), decomposition (*divorce*), single replacement (*one new boyfriend/girlfriend*) and double replacement (*double date switcheroo*).
  - **Synthesis** reactions are represented by the general equation **A + B → C**. (all added together as 1 product)
  - **Decomposition** reactions are represented by the general equation **C → A + B**. (broken apart into multiple products)
  - **Single-displacement** reactions are represented by the general equation **D + EF → DE + F**.
  - **Double-displacement** reactions are represented by the general equation **PQ + RS → PR + QS**.
  - In a **combustion** reaction, a substance combines with oxygen, releasing energy in the form of heat and light.
    - Combustion (a.k.a. burning) reactions are a special sub-type of reaction where oxygen combines with a reactant to produce oxides and heat & light (flame). **$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ + *Heat***

Ch. 8 REVIEW:

STATE OF MATTER SYMBOLS	
Symbol	**Meaning**
(*s*)	solid
(*l*)	liquid
(*g*)	gas
(*cr*)	crystalline solid
(*aq*)	aqueous (dissolved in water)

REACTION CONDITIONS	
Symbol	**Meaning**
→	"produces" or "yields", indicates result of reaction
⇌	reversible reaction in which products can reform into reactants; final result is a mixture of products and reactants
 or 	Reactants are heated; temperature is not specified
 or 	Name or chemical formula of a catalyst, added to speed a reaction

CLASSIFICATIONS OF COMMON CHEMICAL REACTIONS		
Reaction	**General Equation**	**Description**
combustion ***** *classify these first!* *****	**O_2** + *??* → *??* + **H_20**	**oxygen** + *??* → *??* + **water**
synthesis	*A* + *X* → *AX*	add together
decomposition	*AX* → *A* + *X*	break apart
single displacement/replacement	*A* + *BX* → *AX* + *B*	one new bond
double displacement/replacement	*AX* + *BY* → *AY* + *BX*	two new bonds
acid-base	**H***A* + *B***OH** → *AB* + **H_20**	**H** and **OH** → **water**
oxidation-reduction (redox)	A^+ + *B* → *A* + B^+	has charges

DIATOMIC MOLECULES	
BRINCLHOF / "magic 7"	Br_2 I_2 N_2 Cl_2 H_2 O_2 F_2

8.3: ACTIVITY SERIES OF THE ELEMENTS

- ***Vocabulary***
  - **activity series** -- a series of elements that have similar properties and that are arranged in descending order of chemical activity; examples of activity series include metals and halogens
- ***Chapter Highlights***
  - Activity series list the elements in order of their chemical reactivity and are useful in predicting whether a chemical reaction will occur.
  - Chemists determine activity series through experiments.