Chapter 4: chemical Equations and Stoichiometry

1. Write word equations and symbolic equations for chemical reactions.
2. Determine the reactant(s) in excess, the limiting reagent, and the amounts of products obtained in a chemical reaction using aqueous solutions.
3. Identify compounds according to whether they are non-, weak, or strong electrolytes; strong or weak acids or bases; or salts.
4. State general rules that apply to the aqueous solubilities of ionic compounds, and write net ionic equations based on these solubility rules
5. Identify the metals that readily dissolve in common mineral acids and those that do not.
6. Write molecular, ionic, and net ionic equations for processes in aqueous solutions.
7. Write net ionic equations for neutralization reactions and for reactions that result in the dissolving (dissolution) of a water-soluble substance or the evolution of a gas.
8. Write equations that show the ionization of acids and bases in water.
9. Distinguish between monaprotic, diprotic and triprotic acids
10. Recognize an oxidation-reduction reaction by changes in oxidation state and identify the oxidizing and reducing agents in an oxidation-reduction reaction.
11. Separate an oxidation-reduction equation into half equations; complete and balance the half equations; and recombine them into a balanced net oxidation-reduction equation. (Simple reactions)
12. Calculate oxidation numbers
13. Given an activity series chart, use it to make predictions about the products of a single displacement reaction.
14. Define the terms associated with solutions, including molarity; compute molarities and solution volumes.
15. Solve stoichiometry problems when either the reactants or the products are species in solution and concentration and volume data are given.
16. Apply precipitation analysis to determine atomic weights.
17. Be familiar with the technique of titration—how the experiment is performed, what data are collected, why an indicator is used, and how to use the data.
18. Draw conclusions about the presence or absence of ions in an unknown from experimental observations.
19. Predict the combustion products particularly of carbon and hydrogen and carbon-hydrogen-oxygen compounds—and write a balanced equation.
20. Practice chemical nomenclature.
21. Predict the products of some simple types of chemical reactions: combination, decomposition, displacement, and metathesis reactions.

Concentration	Amount of solute in a given amount of solution
Unsaturated and saturated	A solution is said to be saturated if it contains less solute than the maximum it can hold and is said to be saturated if it contains the maximum.
Molarity	Moles of solute per liter of solution
Equation for molarity	$M = \frac{mol}{L}$, M is molarity; mol is moles of solute; L is liters of solution [not solvent]
Meaning of 1.00M NaCl (aq) or $[NaCl_{(aq)}] = 1.00M$	1.00 molar aqueous NaCl solution. 1.00 mol NaCl dissolved in enough water to make 1.00 L of solution.

Meaning of brackets,[ ],for example[NaCl]	Brackets always designate the molarity of the species shown in the brackets[NaCl] means concentration of NaCl in moles per liter
Dilution	Preparation of one aqueous solution from another by adding water.
Water + nonmetal oxide	Acid $2\ H_2O_{(l)} + CO_{2(aq)} \rightarrow H_3O^+_{(aq)}\ HCO_3^-{}_{(aq)}$
Water + metal oxide	Base $H_2O_{(l)} + Na_2O_{(s)} \rightarrow 2\ Na^+_{(aq)} + 2\ OH^-_{(aq)}$
Neutralization	Reaction of an acid with a base
Salt	An ionic compound that is not an acid, base, or oxide, sodium chloride is one example. Salts are one of the products of a neutralization
Spectator ion	In an ionic equation, an ion that appears in the reactants and in the products is a spectator ion. For example, in the reaction of $HCl_{(aq)} + NaOH \rightarrow H_2O_{(l)} + NaCl_{(aq)}$, the ionic equation formed is: $H^+_{(aq)} + Cl^-_{(aq)} + Na^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)} + Na^+_{(aq)} + Cl^-_{(aq)}$. Because $Na^+_{(aq)}$ and $Cl^-_{(aq)}$ appear unchanged on both sides of the equation, they are spectator ions
Difference between ionic and net ionic equations	A net ionic equation is formed from the corresponding ionic equation by removing the spectator ions. For example the net ionic equation for the above reaction would be: $H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$
Precipitation reaction	Reaction in which an insoluble ionic compound is formed in an aqueous solution
Precipitate	The insoluble ionic compound that is formed in a precipitation reaction
Acid + metal	Hydrogen + salt $2\ HCl_{(aq)} + Zn_{(s)} \rightarrow H_{2(g)} + ZnCl_{2(aq)}$
Water + group 1A metal	Hydrogen + metal hydroxide $2\ H_2O_{(l)} + 2\ K_{(s)} \rightarrow KOH_{(aq)} + H_{2(g)}$
Water + group 2A metal	Hydrogen + metal hydroxide (slower reaction) $H_2O_{(l)} + Ca_{(s)} \rightarrow H_{2(g)} + Ca(OH)_{2(aq)}$
Gas that's produced from Carbonate + acid Sulfite and acid Sulfide + acid	CO_2 : $Na_2CO_3 + 2\ HCl_{(aq)} \rightarrow CO_{2(g)} + H_2O_{(l)} + 2\ NaCl_{(aq)}$ SO_2; $Na_2SO_{3(aq)} + 2\ HCl_{(aq)} \rightarrow H_2O_{(l)} + SO_{2(g)} + 2\ NaCl_{(aq)}$ H_2S; $Na_2S_{(aq)} + 2\ HCl_{(aq)} \rightarrow H_2S_{(g)} + 2\ NaCl_{(aq)}$
Replacement reaction	Reaction in which the ions of one metal replace the ion of another metal in aqueous solution.
General equation for a single displacement	metal A + aqueous solution of salt of metal A → metal B + aqueous solution of salt of metal B
Activity series	A list of symbols for elements that shows their replacement priority: The list is arranged so that the ions of a metal that's higher on the list will replace the ions of a metal that's lower in aqueous solution.
Reduction-oxidation (redox)	Reaction in which electrons are transferred from one substance to

reaction	another. One example is $Mg_{(s)} + 2\ Ag^{+}_{(aq)} \rightarrow Mg^{2+}_{(aq)} + 2\ Ag_{(s)}$
Oxidized	In a redox reaction the substance that loses electrons is said to be oxidized. In the preceding example Mg is oxidized
Reduced	In a redox reaction the substances that gas electrons is said to be reduced. In the preceding example Ag^{-} is reduced
Steps in predicting the formula for a compound	All formulas for compounds whether ionic or covalent have a zero (neutral) charge. Look at the anion's charge. Most anions are made of non-metal ions. Monatomic anions have charges that are based on the column location in the periodic table: VIIA is —1, VIA is —2, and VA is —3. Polyatomic anions have set charges, which you need to know. Look at the cation's charge, which one gets from the name: the ionic compound Copper (II) chloride; the copper is +2 that means 2 Cl^{-} are need to balance the charge. $CuCl_2$. Covalent names tell you the number of each cation and anion in the name. Dinitrogen trioxide: there are two nitrogens and three oxygens: N_2O_3.
Steps in predicting the equation for the formation of a compound from its elements from the elements	Write the symbols or formulas for the reactants and products for the formation of the compound from its elements. Balance the equation.
Relationship among formulas for compounds of elements in the same group	Elements in the same group form compounds with similar formulas. Example: NaCl and KCl, Na_2O and K_2O.
Meaning of $_{(aq)}$	Aqueous, dissolved in water
Difference between H an other group 1A elements in bonding with nonmetals	H usually forms single, polar, covalent bonds; Alkali metals always form 1+ cations