Chemistry 161-06 **Unit 2** **Fall '17**

10/18 Laboratory: Analysis of Orthophosphate
Prelaboratory Assignment (p.56 - 57) due at start of lab. Report due 10/24.

10/19 Outcomes:

1. To know and use the terms that relate components of chemical equations: reactants, products, coefficients, balanced, and other notations that communicate information from chemical equations in several styles.
2. To interpret chemical equations on a molecular basis and on a mole basis, using fractional and integer coefficients.
3. To know reactants and products specific to combustion reactions.
4. To explain and use the equalities between masses of reactants and products, and atoms of reactants and products; to use coefficients to explain differences in the number of moles and molecules.
5. To use "guess-and-check" skills to obtain balanced chemical equations given known reactants and products.
6. To build and use stoichiometric (mole) ratios as conversion factors to obtain moles and masses of reactants and products.
7. To define and identify the limiting reactant from two techniques: from "inspection", or by using the format of an "i.c.f." table (not in book).
8. To use limiting reactant to determine theoretical yield, and apply data from experiments to determine percent yield.

Read §3.3, 3.4, 3.5, 3.9. Reading quiz on these sections.
Recommended exercises: From the above sections, all in-chapter Sample and Practice Exercises, and select chapter-end Questions and Problems.

10/24 Outcomes:

1. To contrast strong electrolytes from weak and non-electrolytes (and distinguish these from concentration).
2. To show weak electrolytes and related ions in chemical equations that do not go to completion.
3. To recognize and describe the action of acids and bases by two definitions: Arrhenius' and Bronsted-Lowry.
4. To describe the reaction of hydrogen ion and hydroxide ion as neutralization, and the ionic substance that is also a product as a salt. To write the salt in dissociated (ionic) and whole-formula forms.
5. To write and interpret acid-base reactions in whole-formula (molecular), overall ionic (total ionic) and net ionic formats, and identify spectator ions.
6. To recognize and describe strong and weak acids as strong and weak electrolytes (not related to concentration), and their dissociation reactions that do, or do not go to completion.
7. To memorize that HCl, HBr, HNO_3, and H_2SO_4 (first H^+) are strong acids.
8. To memorize that group I metal-hydroxides are strong bases.
9. To know and use the terms describing precipitation reactions.
10. To memorize a set of solubility rules to predict solubilities and when precipitation reactions should occur.
11. To apply the above skills to write whole-formula and ionic equations for precipitation reactions.
12. To prepare for lab on 10/25.

Read §4.4, 4.5, 4.7. Reading quiz on these sections.
Recommended exercises: From the above sections, all in-chapter Sample and Practice Exercises, and select chapter-end Questions and Problems.
Analysis of Orthophosphate lab report due: See specifications on p. 51.
Graded Homework exercises due at start of class: Chapter 3 (pp 123 – 128), #3.4 (explain), 3.50, 3.56 (explain), 3.62a (show work), 3.77a,c (show work), 3.84 (show work), 3.112 (show i.c.f. table).

10/25 Laboratory: Reactions in Aqueous Solutions
Prelaboratory Assignment (p.65) due at start of lab. Report due 10/31.

10/26 Outcomes:

1. To describe and use the terminology of the process of titration as it pertains to neutralization reactions.
2. To contrast the meanings of end point and equivalence point and describe how each can be determined.
3. To view titration as a reaction involving two limiting reactants when it is brought to its equivalence point.
4. To apply quantitative determinations of moles from solution volumes and concentrations along with stoichiometric conversion factors to predict titration volumes, and to analyze unknown concentrations.
5. To describe the purpose and applications of ion exchange; to describe its mechanism in qualitative terms.
6. To use the principle of charge balance to describe the mechanism of ion exchange on a "molecular" level.
7. To describe and interpret oxidation-reduction ("redox") reactions as a concerted process involving the exchange of electrons among reactants.
8. To use the terms oxidizing agent and reducing agent to describe the role of reactants.
9. To recognize oxidation-reduction reactions using several techniques: reactions of elements, changes in monatomic ion charges, and changes in the count of hydrogen and oxygen atoms in molecules*.

* Outcomes #9, 10, and 13 are simpler / shorter than described in the textbook.

10. To assign and use oxidation numbers to identify and describe oxidation numbers, and apply them to redox reactions when the previous techniques do not apply*.
11. To be able to separate redox reactions into half-reactions and correctly write electrons as reactants and products.
12. To be able to balance simple half-reactions "by inspection" using the principle of charge balance, and combine balanced half-reactions to obtain balanced overall reactions.
13. To use a table of Standard Reduction Potentials to obtain balanced half-reactions*.
14. To use an activity series table to describe materials that can oxidize other materials.

Read §4.6, 4.8, 4.9. Reading quiz on these sections.

Recommended exercises: From the above sections, all in-chapter Sample and Practice Exercises, and select chapter-end Questions and Problems.

10/31 Outcomes:

1. To interpret equations that show heat energy as a reactant or a product.
2. To describe qualitatively differences among potential energy, kinetic energy and work, and the law of conservation of energy.
3. To know the definition of a state function, and how potential energy is one example of a state function.
4. (Not in book): To know and interpret that energy can only be measured through change, from an initial state to a final state, and calculated as (final – initial).
5. To relate the motion of molecules to kinetic energy, and chemical bond energy to potential energy.
6. To explain verbally and interpret in graphical form how if heat is produced in a chemical or physical change, the chemicals have changed from a higher potential energy state to a lower potential energy state.
7. To describe the change in the previous outcome as exothermic and the reverse as endothermic.
8. To know how and why to differentiate among the "system" (what we study), the "surroundings" (what the system exchanges energy with), and the "rest of the universe" (note differences from text).
9. To apply the definitions of open, closed and isolated systems, and the example (§5.5) of a "bomb" calorimeter.
10. To describe how we measure heat change in the surroundings, and relate that to an opposite change in the system.
11. To describe the process and the energy changes during melting.
12. To use and convert various energy units.
13. To express one form of the law of conservation of energy in the format of the First Law of Thermodynamics.
14. To use familiar examples of pressure – volume work of gases as examples of work and energy flow between system and surroundings.
15. To define Internal Energy, E, as the sum of all of a system's kinetic and potential energies, the Internal Energy Change (ΔE) as $E_{final} – E_{initial}$, and equate this to the sum of heat changes (q) and the work changes (w).

Read §5.1, 5.2. Reading quiz on these sections.

Recommended exercises: From the above sections, all in-chapter Sample and Practice Exercises, and select chapter-end Questions and Problems.

Reactions in Aqueous Solutions lab report due.

Laboratory Notebooks due for grading.

Graded Homework due at start of class: Chapter 4 (pp 186 - 191): 4.2, 4.16c, 4.32, 4.44, 4.48 (explain), 4.58a,b, 4.63c (show work), 4.78, 4.102a,d, 4.106b (balance electrons first)

11/1: Non-Instructional Day (No classes or laboratories)

11/2 Outcomes:

1. To define, for convenience, Enthalpy Change (ΔH) to be the heat change at constant pressure, which is the condition for many reactions and for one important type of calorimeter.
2. To be able to interpret its relationship to Internal Energy change.
3. To relate the sign of DH to final vs. initial conditions and to exothermic and endothermic reactions.
4. To contrast and clearly interpret the difference between heat witten as a reactant or product vs. heat written as an Enthalpy change of a chemical reaction.
5. To interpret heating curves for substances and their phase changes and as one expression to the resistance to temperature change (the heat capacity).
6. To know that water has one of the largest heat capacities of all substances and how that results in important features of ocean and atmospheric properties.
7. To use a heating curve as an illustration of the heat of fusion (melting) and heat of vaporization. To relate these heats and the energy they represent to the molecular view of the changes.
8. To know the definitions and symbols of molar heat capacity, specific heat, and total heat capacity, and develop flexibility for different symbols that are commonly used for each.
9. To use equations for the proportionality of heat, heat capacity, and temperature change to solve problems.
10. To view a calorimeter as a near-isolated system and use conservation of energy to quantify heat changes.
11. To solve problems for heat of reaction using calorimetry and temperature changes.
12. To equate heat of reaction to Enthalpy of reaction when using a constant-pressure calorimeter.
13. To express the enthalpy of reaction in a format (ΔH_{rxn}) that emphasizes energy change (final – initial) rather than writing heat as a reactant or product.
14. To equate heat of reaction to Internal Energy change when using a constant-volume calorimeter.

Read §5.3, 5.4, 5.5. Reading quiz on these sections.

Recommended exercises: From the above sections, all in-chapter Sample and Practice Exercises, and select chapter-end Questions and Problems.

11/7 Outcomes:

1. To apply the properties of state functions to allow adding enthalpies when adding reactions, and changing signs of enthalpies when reversing reactions.
2. To apply enthalpy potential energy diagrams to describe and predict changes along various reaction "pathways."
3. To know what conditions a standard enthalpy (heat) of reaction refers to, and the difference between it and a standard enthalpy (heat) of formation.
4. To use enthalpy as a state function to figure out heat changes for reactions we do not perform: from enthalpies of reactions, or from standard enthalpies of formation.

Read §5.6, 5.7. Reading quiz on these sections.

Recommended exercises: From the above sections, all in-chapter Sample and Practice Exercises, and select chapter-end Questions and Problems.

11/8 Laboratory: Heat of Reaction (Thermochemistry)

Prelaboratory Assignment (pp. 83-84) due at start of lab. Report due 11/14.

11/9: Problem-Solving Session

1. To apply concepts and skills learned throughout Unit 2 to solving problems.
2. To prepare for laboratory on 11/15.

(No new reading assignment nor reading quiz.)

Graded Homework, pp. 249 - 253: 5.8, 5.20 (for the system), 5.36, 5.62, 5.64 (see p. 229), 5.70 (assume 250.0 g total), 5.72 (assume 1 L = 1 kg), 5.78, 5.86, 5.92 (show work)

11/14 Outcomes:

Group Sheet 2

Hour exam on above outcomes and pertinent topics from lab.

11/15 Laboratory: Sodium Hydroxide Solutions

Prelaboratory assignment (p. 70) due at start of lab. Report due 11/21