Chemistry 103 Spring 2010

MW 4:20-5:35 PM in Bio Sciences 144

Instructor Dr. James Rudd

Office Hours MW 3:15-4:20 PM, 5:35-6 PM
T 1-2 PM, and by appointment
Bio Sciences 144 or PS 716

Contact Information (323) 343 – 2309
jrudd@calstatela.edu

Syllabus

1. Handed out and discussed in recitation.
2. Can download at http://www.calstatela.edu/dept/chem/class-notes.htm

Today

1. Brief review of solutions, intermolecular forces, and behavior of liquids.
2. Introduction to chemistry of solutions.

Chemistry
A science that deals with the composition, structure, properties, and transformations of substances.

CHEM 103 builds on concepts and skills developed in CHEM 101 and 102.

Great understanding of:

1. Using the mole concept and ratios to conserve mass:
   - Gram <---> mole conversions (Ch 3)
   - Stoichiometry of compounds and reactions (Ch 3 and 4)
   - Empirical formula (Ch 3 and 4)
   - Molarity (Ch 5)

2. Applying the concept of equilibrium to chemical processes (Ch 13)

3. Applying Hess's Law to chemical processes (Ch 6)

General understanding of:

1. Measuring scientifically (Ch 2),
2. Naming chemicals and writing chemical equations (Ch 1, 3, 4),
3. Chemical reactivity for precipitation and acid-base reactions (Ch 5),
4. Solution chemistry (Ch 5),
5. Using ratios to conserve energy (Ch 6).
6. Applying the concept of intermolecular forces (Ch 9).

CHEM 103 will focus on:

1. Solutions and their properties (Ch 14),

2. Equilibrium for acids and bases (Ch 15),

3. Equilibrium for buffers and salt solutions (Ch 16),

4. Thermodynamic principles (Ch 17),

5. Electrochemical processes (Ch 18).

Success in CHEM 103:

1. Keep up with your studies:
   20 hours a week equals 2-3 hours each day

2. Study and practice outside of class
   (study groups)

3. Practice during class

4. Work in groups during class

Job success is more than knowing the subject

1. Study and learning skills
   (How well can you work on your own?)

2. Teamwork, leadership, and communication skills
   (How well can you work with other people?)

Review of solutions

Solution: a homogeneous mixture of two or more substances. Example: water, sugar, flavor mixture (Coke). The substances are physically combined, not chemically combined or bonded to each other.

Nanoscale pictures: Figs. 5.1, 5.4, and 5.5

Solvent: usually the substance in the greater amount. The substance used to dissolve the solute or solutes. Example: water.

Solute: usually the substance in the lesser amount. The substance dissolved by the solvent. Example: sugar.

Concentration: the ratio of the amount of solute to the total amount of solution. Examples: 80 proof alcohol, 3% hydrogen peroxide, 12 M HCl.

In chemistry, we use **molarity** (M) because it's based on moles and the mole ratio concept (Ch 3 and 4).

$$\text{Molarity} = \frac{\text{moles of solute}}{\text{volume of solution}} = \frac{\text{mol}}{\text{L}} = \text{M}$$

For some colligative properties (Ch 14.7), **molality** (*m*) is used to calculate properties of solutions (Ch 14, p. 520).

$$\text{Molality} = \frac{\text{moles of solute}}{\text{kg of solvent}} = \frac{\text{mol}}{\text{kg}} = m$$

Solutions and equilibrium

saturated: a solution that has reached the solubility limit of the solute; no more solute can dissolve in the solution; $Q = K_c$; dynamic equilibrium between dissolved and undissolved solute.

solubility (solubility limit): the maximum amount of solute that can dissolve in a solvent.

unsaturated: the solution has not reached the solubility limit of the solute; the solute concentration is less than the maximum possible concentration; $Q < K_c$; equilibrium has not been reached.

Solutions and intermolecular forces

Solubility depends on intermolecular forces.

Substances with similar intermolecular forces (noncovalent forces, p. 507) are likely soluble in each other.

"like dissolves like" (p. 507)

Example: Fig. 14.1, p. 506.

Intermolecular forces (IMF's): the forces between two or more molecules, noncovalent interactions between molecules, usually weaker than chemical bonds.

Four main types of IMF's (Ch 9):

1. Dipole-dipole forces (dipolar forces, permanent dipole forces)
2. London forces (dispersion forces, induced dipole forces, temporary dipole forces)
3. Hydrogen bonding
4. Ion-dipole forces (Ch 14, pp. 511-512)

Practice and review: Explain why formic acid HCOOH and acetic acid CH_3COOH are very soluble in water, while fatty acids, such as stearic acid $CH_3(CH_2)_{16}COOH$ and palmitic acid $CH_3(CH_2)_{14}COOH$ are not soluble in water.

Properties of solutions

colligative property: a property of a solution that depends only on the concentration of solute particles, not the type of particles.

4 main types of colligative properites (Ch 14.7):
1. Vapor pressure lowering,
2. Boiling point elevation (ΔT_b),
3. Freezing point lowering (ΔT_f),
4. Osmotic pressure (Π).

As a reminder from Chapter 11,
Vapor pressure results from liquid particles at the surface moving into the gas (vapor) phase.

Boiling occurs when liquid particles at the surface *and* in the bulk move into the gas phase. (compared to evaporation where only liquid particles at the surface move into the gas phase)

Freezing occurs when liquid particles throughout the bulk lock together in an extended array in the solid phase.

Announcements

1. CSULA closure on Mar. 31 (holiday).
2. CSULA closure on Apr. 2 (furlough).
3. CSULA closure on May 21 (furlough).
4. CSULA closure on May 31 (holiday).

5. DROP deadline on Apr. 6, Tuesday.
6. ADD deadline on Apr. 12, Monday.

7. First midterm exam on Apr. 19 or 21.
8. Bring textbook and calculator to each lecture.

OWL Homework (e-graded homework)

Before next class,

1. Study Chapter 14.1, 14.3, and molarity and molality (pp.518-521).
2. Read Chapter 14.2. and 14.7.