CHEM 116 Solutions

FSG is Mondays 11:00 am and Tuesdays 3:30 pm both in S-1-89 Lecture 8 Prof. Sevian

Exam 1 is postponed to Thursday, October 2



Today's agenda

Start chapter 13: Solutions

- Definition
- Saturation and solubility
- Solvation process at particle level
- Energetics of dissolving

Summarizing Intermolecular Forces

From weakest to strongest



Comparing substances

What do you predict to be the order of normal boiling points for these substances? Put them in order by placing a 1 for the lowest boiling point and a 4 for the highest. Then explain why.



Practice telling which IM forces



(A) I only

(B) I and II

(C) I and III

(D) II only

(E) IV only

What kinds of intermolecular forces hold I. London dispersion the following condensed phases together? II. Dipole-dipole III. Hydrogen bonding

- $H_2O(l)$ 1.
- 2. $CO_2(s)$ IV. Ion-ion a) $CO_2(g)$ dissolved in water [known as $CO_2(aq)$] $NH_3(l)$ 3.
 - a) $NH_3(g)$ dissolved in water [known as $NH_3(aq)$]
- $CaCl_{2}(s)$ 4.
- Octane, $C_8H_{18}(l)$ 5.
- Diethyl ether, CH₃-CH₂-O-CH₂-CH₃ T_{boil}=308K 6.
- 2-butanol, CH₃-CHOH-CH₂-CH₃ T_{boil}=372K - 7. Note that both of these have the same chemical formula: $C_4H_{10}O$



Complicated explanations

rom Chemistry & Chemical Reactivity 5th edition by Kotz / reichel. C 2003. Reprinted with permission of Brooks/Cole, vision of Thomson Learning: <u>www.thomsonrights.com</u>. Fax division of Tho 800-730-2215



Key points about IM forces of attraction

- Intermolecular forces (IM forces) are <u>attractive forces that act</u> <u>between one particle (e.g. molecule) and another</u> in the liquid and solid phases
- What kinds of IM forces exist depends on what kinds of particles they are
 - Molecular particles
 - Non-polar molecules
 - Polar molecules
 - Polar molecules that have an H bonded to either N, O, F or Cl
 - Ionic particles
- Some IM forces are stronger than others
- If a molecular compound has dipole-dipole (or H-bonding category of d-d) forces, it also has London dispersion forces
- In larger molecules, the London dispersion forces predominate, even if dipole-dipole forces are present

Mixed intermolecular forces

- Ion dipole
 - The ion causes the dipoles to orient in ways that increase attractions
 - This explains solvation of an ionic compound in water or other polar solvents (e.g., Na⁺ and Cl⁻ ions in water)
- Dipole non-polar molecule
 - The dipole causes the non-polar molecules to form more temporary dipoles
 - This causes the non-polar molecules to orient in ways that increase attractions
 - This explains why it is possible to dissolve tiny amounts of non-polar chemicals in a polar solvent (*e.g.*, oxygen gas in water)



About Exam 1 (Thurs Oct 2 in class)

- Chapters 10 and 11 will be covered on Exam 1
- Please read the information about exams on the course website
- Key points:
 - You will need a calculator devices that are capable of communication (e.g.,PDA devices, cell phones, some graphing calculators) are not allowed
 - Bring a pencil and eraser
 - Scratch paper will be provided you are not permitted to use your own
 - The exam starts at the beginning of class (2:00) and ends at the end of class (3:15) please be on time so that you will have the complete time
 - Please sit every other seat in every other row