Warm up

1. What is a solution?
2. What is a solute?
3. What is a solvent?

Solutions

Chapter 12.2

Solubility

- The amount of substance that can dissolve at a given temperature to produce a saturated solution

Saturation

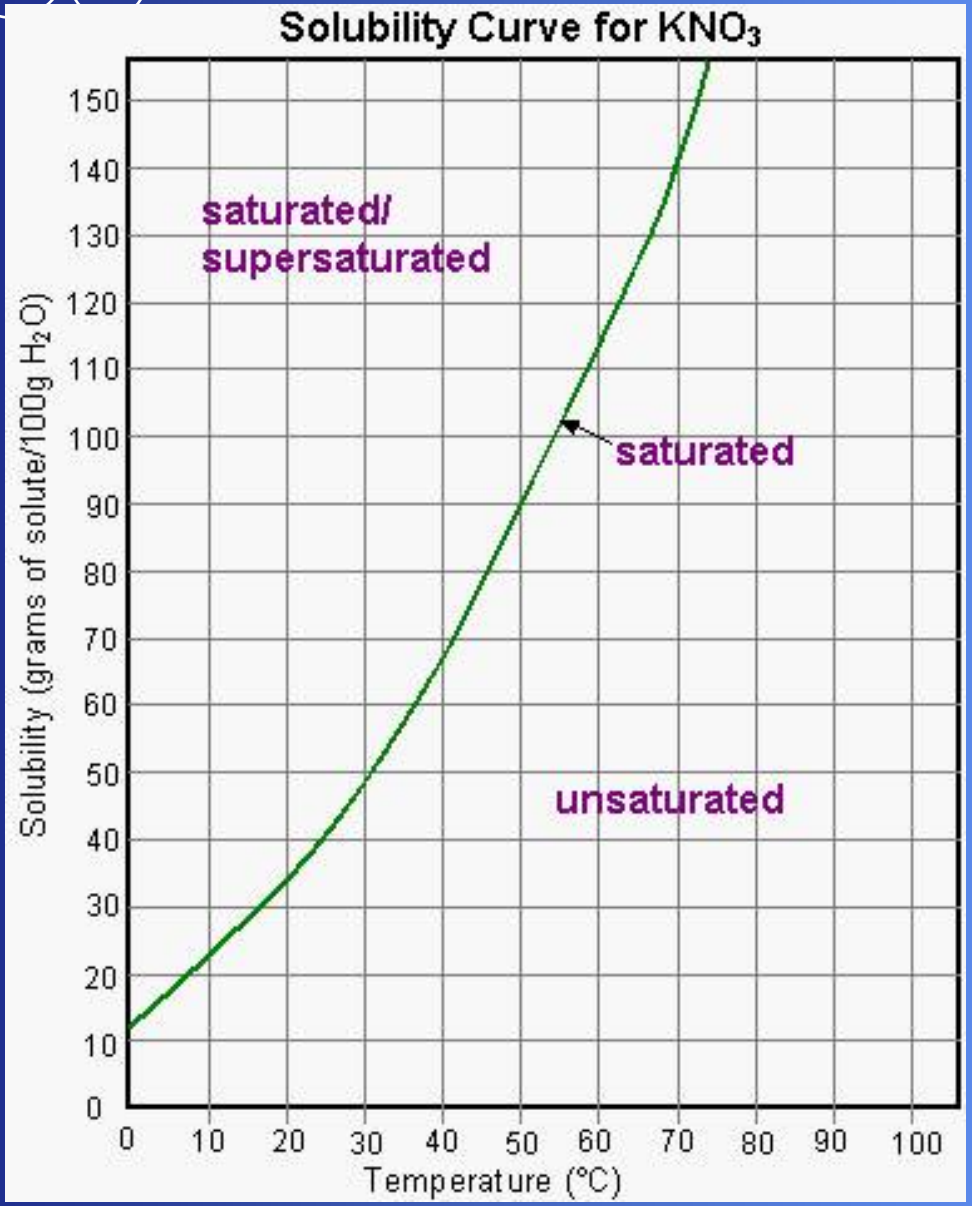
Unsaturated

↓ additional solute

Saturated

↓ additional solute

Supersaturated


Solubility Curve for KNO_3
saturated/
supersaturated
saturated
unsaturated
Solubility (grams of solute/100g H_2O)
Temperature (°C)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150

Miscible vs. Immiscible

Miscible- when 2 liquids can dissolve in each other.

Imiscible- when liquids are insoluable in each other.

- Remember likes dissolve likes
  - polar covalent/ionic dissolve each other
  - Nonpolar dissolve nonpolar

Henry's Law

Henry's Law- as the pressure (P) of the gas above a liquid increases the solubility (S) of gas increases. (And vice versa)

$$\frac{S_1}{P_1} = \frac{S_2}{P_2}$$

Example: If the soulubility of a gas in water is 0.77 g/L at 3.5 atm of pressure, what is its solubilty at 1.0 atm of pressure?

Henry's Law- Practice

Example: If the soulubility of a gas in water is 0.77 g/L at 3.5 atm of pressure, what is its solubilty at 1.0 atm of pressure?

$$\frac{S_1}{P_1} = \frac{S_2}{P_2} \quad \text{or} \quad S_2 = \frac{S_1 \times P_2}{P_1} =$$

$$S_2 = \frac{0.77\text{g/L} \times 1.0\text{ atm}}{3.5\text{ atm}} = = 0.22\text{g/L}$$

Factors Affecting Solubility

- As temperature increases
  - Solubility of liquids & solids generally increases
  - Solubility of GASES decreases
- As pressure increases
  - generally no effect on solubility of liquids & solids
  - Solubility of GASES increases
- As surface area increases-by stirring
  - *Rate* of Solvation increase!

CONCENTRATION OF SOLUTIONS

- Concentration—measurement of how much solute is in a given amount of solvent.
  - Diluted solution—a relatively small amount of solute.
  - Concentrated solution—a relatively large amount of solute.

These are not very definite terms.

Measuring Concentration

- **Molarity (M)-number of moles of solute in 1 L of solution.**

$$M = \frac{\text{Moles solute}}{\text{Liters solvent}}$$

- 4.0 moles of LiCl is dissolved in 5.0 liters of water. What is the molarity of the solution?

$$\frac{4.0 \text{ moles LiCl}}{5.0 \text{ liters } H_2O} = 0.8 \text{ M LiCl}$$

Molarity Practice

1) 6.0 mol of $MgCl_2$ is dissolved in 20.0 L of water. What is the molarity of the solution?

$$\frac{6.0 \text{ mol } MgCl_2}{20.0 \text{ L } H_2O} = 0.3 \text{ M } MgCl_2$$

MOLALITY

- Molality—a way to express the solute to solvent ratio, molal concentration.
  - Symbol=μ or cursive lower case m

- Number of moles of solute dissolved in 1 kg of solvent.

Molality (m or μ)= $\frac{\text{Moles solute}}{\text{Kg solvent}}$

Practice problems

- **Molality (m)**

$$\frac{\text{Moles solute}}{\text{Kg solvent}}$$

1) If you add 0.5 mol of sugar ($C_6H_{12}O_6$) to 2.0Kg of water what is the molality?

0.25 m or μ

2) Determine the molality of a solution of 560 g of acetone, CH_3COCH_3, in 620 g of water.

Remember- 1kg=1000g

- 16 m or μ

3) What is the molality of a solution of 12.9 g of fructose, $C_6H_{12}O_6$, in 31.0 g of water?

- 2.31 μ

Making Dilutions

$M_1V_1 = M_2V_2$

M=Molarity & V=Volume

1) Dilute 1.0L of 5.0 M SrS to 2.0M. What is the final volume?

$(5.0\ M\ SrS)(1.0L) = (2.0M\ SrS)(V_2)$

$V_2 = 2.5\ L$

How much water would you need to add?

If the total volume = 2.5L & original volume is 1.0L

Need to add 1.5L of water to make the dilution

LET'S PRACTICE

2) How would you prepare 100. mL of a 0.500 M HNO_3 solution if you have a 12.0 M stock solution of HNO_3?

- $M_1V_1=M_2V_2$
- $M_1=12.0$ M
- $V_1=?$
- $M_2=0.500$ M
- $V_2=100.$mL
- $V_1=4.17$ mL
- Amount of water added to $V_1=95.83$ mL

Colligative Properties

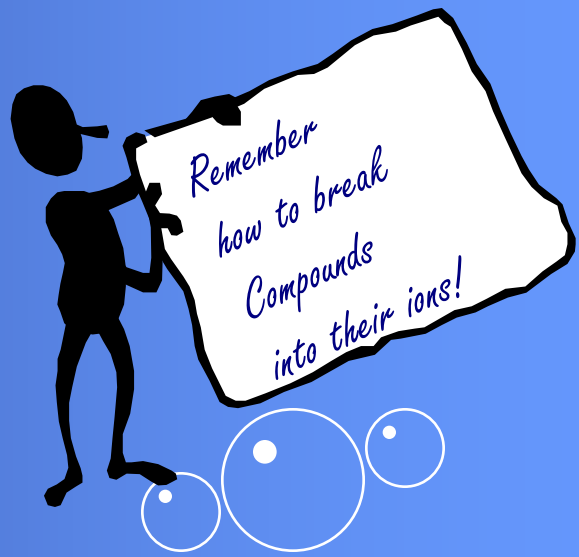
Chapter 18.3-18.4

https://youtu.be/WrIg-rUmtfk

Colligative Properties

Physical properties of solution that are affected by the number of solute particles.

- Based on molality (*m*)
- Electrolytes produce multiple particles
- Nonelectrolytes are 1 particle
- depend only on the number of dissolved particles in solution and not on their identity



Colligative properties

- Vapor pressure lowers
- Boiling point rises
- Freezing point lowers
- Osmotic pressure increases

Ion Formation Practice

Break the following compounds into ions and identify how many particles there are!

$NaCl$

$Na^{+} + Cl^{-}$

BaI_2

$Ba^{2+} + 2I^{-}$

AlF_3

$Al^{3+} + 3F^{-}$

$C_6H_{12}O_6$

$C_6H_{12}O_6$

C_2H_5OH

C_2H_5OH

Boiling Point Elevation

- As solute increases boiling point increase!

Why?

- Solute decreases vapor pressure
- It will take more energy for the vapor pressure to equal atmospheric pressure

So…

- You have to add more heat to get the solution to boil!

Freezing Point Depression

- As solute increases freezing point decreases

Why?

- When substances freeze they form an orderly pattern
- When there are solutes in solution they disrupt the pattern

So…

- You must remove more heat to freeze a solution