CHEM 1120- 14.1-2

[Spell Card]

Solutions

- Solutions are homogeneous mixtures
  - Two or more substances make up a mixture
- Solutions have a **solute** component and a **solvent** component
  - The majority component of a solution is called the solvent
  - The minority component is called the solute
  - The solute is dissolved into the solvent
- Solution formation is the result of the interaction of the intermolecular forces of the solute and solvent particles
  - "Like dissolves in like"

In Aqueous solution, water is the solvent and a solid, liquid, or gas is the solute

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CHEM 1120- 14.2

[Spell Card]

TABLE 14.2 Relative Interactions and Solution Formation

Solvent-solute interactions	>	Solvent-solvent and solute-solute interactions	Solution generally forms*
Solvent-solute interactions	=	Solvent-solvent and solute-solute interactions	Solution generally forms*
Solvent-solute interactions	<	Solvent-solvent and solute-solute interactions	Solution may or may not form, depending on relative disparity

*In some cases, especially solutions involving water, solvent structural changes that occur during solvation result in *decreases in entropy*, which may also prevent solution formation.

Dissolution is breaking apart; Recrystallization is wanting to go back together

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CHEM 1120- 14.4

[Spell Card]

Solubility limit

- A solution that has the solute and solvent in dynamic equilibrium is said to be **saturated**
  - If you add more solute, it will precipitate, not dissolve
  - When mixing gases with liquid solvent, the saturation concentration depends on the temperature and pressure of gases
- A solution that has less solute than saturation is said to be **unsaturated**
  - More solute will dissolve at this temperature
- A solution that has more solute than saturation is said to be **supersaturated**

Solubility of most solids in water increases with temp increasing

Solubility of gases in liquids decreases with temp increasing and increases with pressure increasing

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CHEM 1120- 14.5 #1

[Spell Card]

Solution concentration

Most concentration units are expressed as: $\dfrac{\text{Amount of solute}}{\text{Amount of solvent or solution}}$

- ***Molarity***: *moles* of solute/*liter* of solution
- ***Percent by mass***: *grams* of solute/*grams* of solution (then multiplied by 100%)
- ***Percent by volume***: *milliliters* of solute/*milliliters* of solution (then multiplied by 100%)
- ***Mass/volume percent***: *grams* of solute/*milliliters* of solution (then multiplied by 100%)

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CHEM 1120- 14.5 Prob.1

[Spell Card]

How would you prepare 750 g of an aqueous solution that is 2.5% NaOH by mass?

100g of Solution- 2.5g NaOH= 97.5g H2O
750g*2.5%= 18.75g NaOH; 750g*97.5%= 731.25g H2O
Density H2O= 1.0g/1.0mL
731.25g H2O*1.0mL/1.0g= 731.25mL H2O

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CHEM 1120- 14.5 #2

[Spell Card]

$$\text{Molarity, M} = \frac{\text{moles of solute}}{\text{Liters of solution}}$$

$$\text{molality, m} = \frac{\text{moles of solute}}{\text{kg of solvent}}$$

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CHEM 1120- 14.5 #3

[Spell Card]

Solution Concentration (cont'd)

Most concentration units are expressed as: $\dfrac{\text{Amount of solute}}{\text{Amount of solvent or solution}}$

- ***Parts per million (ppm)***: *grams* of solute/*grams* of solution (then multiplied by 10^6 or 1 million)
- ***Parts per billion (ppb)***: *grams* of solute/*grams* of solution (then multiplied by 10^9 or 1 billion)
- ***Parts per trillion (ppt)***: *grams* of solute/*grams* of solution (then multiplied by 10^{12} or 1 trillion)

- ppm, ppb, ppt ordinarily are used when expressing *extremely* low concentrations (a liter of water that is 1 ppm fluoride contains only 1 mg F^-!)

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CHEM 1120- 14.5 Prob.2

[Spell Card]

The maximum allowable level of lead in drinking water in the United States is 15 parts per billion.

If lead in drinking water can be in the form of $PbCO_3$, calculate the molarity

(moles $PbCO_3$ / L) at the safe threshold.

1.5E-8g Solute/1.0g Solution= 1.5e-8g PbCO3/1.0g H2o*1.0g H2O/1.0mL H2O= 1.5E-8g PbCO3/1.0mL H2O*1000mL H2O/1.0L H2O= 1.5E-8g PbCO3/1.0L H2O
MW=267.2g PbCO3/mol
1.5E-8PbCO3/1L H2O*1mol PbCO3/267.2g=5.6E-8mol PbCO3/1L H2O
M=5.6E-8mol/L

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