Solutions

Solubility: the amount of a solute that dissolves in a given amount of solvent (usually 100 g water) at a particular temperature, forming a saturated solution.

Terms: saturated, unsaturated, supersaturated, miscible, immiscible

Factors which affect the rate of at which a solute dissolves are:

Temp, agitation, surface area

General Trends:

- Solids dissolving in liquids: ↑ w/ ↑ Temp
- Gases dissolving in liquids: ↓ w/ ↑ Temp

Molarity: way of expressing concentration. What is the molarity of a 250 mL solution that contains 45.67 grams of Iron III Nitrate $Fe(NO_3)_3 = 241.89 g/mol$

$\frac{.1889 mol}{.25 L} = .76M$

Calculate grams of solute needed: How many grams of silver nitrate are needed to prepare 150 mL of a 0.5 M solution? 12.7g

$AgNO_3 = 169.9 g/mol$ $\frac{x mol}{.150} = .5M$ $x mol = .075 mol$ $.075 mol \times 169.9$

Dilution of solution: What volume of 6 M sulfuric acid is needed to make 450 mL of 3.0 M sulfuric acid? 225mL (what should go into the vol flask first?)

$6M V_1 = (450) 3.0$ $450 - 225 = 225 mL H_2O$

Colligative Properties: page 487 _____

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Such as: page 487 _____

Page 491: molality formula: $m =$ _____

Page 492: #'s 29 and 30

Freezing Point Depression/Boiling Point Elevation Information:

$\Delta T_f = (m)(d_f)(K_f)$
Change in FP = (molality) (dissociation factor) (molal FP constant) (page 494)

$\Delta T_b = (m)(d_f)(K_b)$
Change in BP = (molality) (dissociation factor) (molal BP constant) (page 495)
Covalent compounds have a $d_f = 1$ (they do not break apart to form ions)

Solutions

	I or C	Dissociates/remains	Electrolyte/NonElec	# particles (d_f)
Sugar $C_6H_{12}O_6$	C	remains	NE	1
Sodium chloride NaCl	I	D	E	2
Calcium chloride $CaCl_2$	I	D	E	3

Molality: m = $\frac{\text{mole}}{\text{kg}}$ — $\frac{\text{moles of solute}}{\text{kg of solvent}}$

Change in freezing point = (molality) (dissociation factor) (freezing point constant)

Change in boiling point = (molality) (dissociation factor) (boiling point constant)

solvent	boiling point (°C)	K_b (°C/m)	freezing point (°C)	K_f (°C/m)
benzene, C_6H_6	80	2.53	5.5	5.12
camphor	207.4	5.61	178.8	39.7
carbon tetrachloride, CCl_4	77	5.02	-22	29.8
chloroform, $CHCl_3$	61	3.63	-63.5	4.68
ethanol, C_2H_5OH	78	1.22	-115	1.99
ether	34.6	2.02	-116.3	1.79
phenol	181.8	3.60	40.9	7.40
water, H_2O	100	0.52	0	1.86

Practice Problems:

Calculate the molality of a solution prepared by dissolving 10.0 grams of NaCl in 600 grams of water.

$10.0\text{g} \left(\frac{1\text{mol}}{58.5\text{g}}\right) = .171\text{mol}$ $\qquad \frac{.171\text{mol}}{.6\text{kg}} = .285\text{m}$

$\Delta T_{fp} = m \times d_{H_2O} \times K_{fp}$

Solutions

NaCl : $d_s = 2$

The freezing point of an aqueous solution of sodium chloride is –20.0 °C. What is the molality of the solution? (ans: 5.4 *m*)

$+20 = m \times 2 \times 1.86$

$5.4 = m$

If 0.500 mole of a nonelectrolyte solute are dissolved in 500 grams of ether, what is the freezing point of the solution?

$i = 1$ $\frac{.5}{.5} = 1m$ $\Delta T_f = 1m \times 1 \times 1.79 = 1.79°C$

$T_f = -118.1°C$

A solution of 7.50 grams of a nonelectrolyte in 22.60 grams of water boils at 100.78 °C. What is the molar mass of the compound. (ans: ~~220 g/m~~)

$\Delta T_b = .78 = m \times 1 \times .52$

7.50g mol = .0339 (221 g/mol)

$1.5 = m = \frac{mol}{.0226}$

If I add 45 grams of sodium chloride to 500 grams of water, what will the melting and boiling points be of the resulting solution? $K_b(H_2O) = 0.52$ °C/m and $K_f(H_2O) = 1.86$ °C/m.

$\frac{45g\ NaCl}{58.5g} \frac{1mol}{} = .769mol$ $m = 1.54m$

$\Delta T_f = 1.54m \times 2 \times .52 = 1.6°C$ $\Delta T_b = 1.54m \times 2 \times 1.86 = 5.73$

$T_f = -101.6°C$ $B_p = +85.7°C$ $-5.7°C$ fp

Which solution will have a higher boiling point: A solution containing 105 grams of sucrose ($C_{12}H_{22}O_{11}$) in 500 grams of water or a solution containing 35 grams of sodium chloride in 500 grams of water?

342g/mol

Sucrose Solution $\frac{105g}{342g} \frac{1mol}{} = .307mol$ $\Delta T_b = .614m \times 1 \times .52 = .32°C$

$\frac{.307mol}{.5kg} =$

NaCl Solution $\frac{35g}{58.5g} \frac{1mol}{} = .598$ $\Delta T_b = 1.20m \times 2 \times .52 = 1.25°C$

$\frac{.598}{.5kg}$