

SOLUTIONS

Expressing Concentration of Solutions

- **Mass percentage** : Grams of solute in 100 g of solution.
- **Strength** : Grams of solute in 1 L of solution.
- **Molarity** : Moles of solute in 1 L of solution.
- **Normality** : Gram equivalents of solute in 1 L of solution.
- **Molality** : Moles of solute in 1 kg of solvent.
- **Mole fraction** : Moles of the component / total no. of moles of all components.
- **Parts per million** : Mass of solute in one million (10^6) parts by mass of solution.

Law

- **Henry's law** : $m = K \cdot p$ or $p = K_H \cdot x$ where K_H is Henry's constant having units of pressure.
- **Raoult's law** : For non-volatile solute : $\frac{p^0 - p_s}{p^0} = \frac{n_2}{n_1 + n_2} = x_2$
For volatile components : $p_A = x_A p_A^0$; $p_B = x_B p_B^0$ and $p_{total} = p_A + p_B$

Types of Solutions

- **Ideal solutions** : A-B interactions are of same magnitude as A-A and B-B interactions, $\Delta V_{mix} = 0$ and $\Delta H_{mix} = 0$.
- **Non-ideal solutions** : A-B interactions are of different magnitude than A-A and B-B interactions, $\Delta V_{mix} \neq 0$ and $\Delta H_{mix} \neq 0$.
 - **Non-ideal solutions showing +ve deviations** : A-B interactions are weaker than A-A and B-B interactions, $\Delta V_{mix} = +ve$, $\Delta H_{mix} = +ve$ and resulting vapour pressure is higher than that expected.
 - **Non-ideal solutions showing -ve deviations** : A-B interactions are stronger than A-A and B-B interactions, $\Delta V_{mix} = -ve$, $\Delta H_{mix} = -ve$ and resulting vapour pressure is lower than that expected.
- **Azeotropes** : Constant boiling mixtures.

Colligative Properties

- Colligative properties depend only on the number of particles of solute dissolved in a definite amount of solvent. These are :
 - **Elevation in boiling point** : Boiling point of solution is higher than that of pure solvent. $\Delta T_b = T_b - T_b^0 = K_b \cdot m$
 - **Depression in freezing point** : Freezing point of solution is lower than that of pure solvent. $\Delta T_f = T_f^0 - T_f = K_f \cdot m$
 - **Relative lowering of vapour pressure** :
 $\frac{p^0 - p_s}{p^0} = x_2 = \frac{n_2}{n_1}$ (for dilute solutions, $n_2 \ll n_1$)
 $\frac{p^0 - p_s}{p_s} = \frac{n_2}{n_1}$ (for dilute as well as concentrated solutions)
 - **Osmotic pressure** : $\pi = CRT$

van't Hoff Factor (i) and its Significance

- $i = \frac{\text{Observed value of colligative property}}{\text{Normal value of colligative property}} = \frac{\text{Calculated molecular mass}}{\text{Observed molecular mass}}$
- For solute undergoing association : $\alpha = (1 - i) \frac{n}{n - 1}$; $i < 1$
(Degree of association)
- For solute undergoing dissociation : $\alpha = \frac{i - 1}{n - 1}$; $i > 1$
(Degree of dissociation)
- **Modified colligative properties** :
 $\frac{p^0 - p_s}{p^0} = ix_2$; $\Delta T_b = iK_b \cdot m$, $\Delta T_f = iK_f \cdot m$;
 $\pi = iCRT$

ELECTROCHEMISTRY

Basic Terms

- **Conductance** : Reciprocal of resistance.
 $C = \frac{1}{R}$; Unit : Ω^{-1} or S
- **Conductivity** : Conductance of 1 cm³ of the conductor.
 $\kappa = C \times \frac{l}{a}$; Unit : $\Omega^{-1} \text{ cm}^{-1}$ or $S \text{ cm}^{-1}$
- **Equivalent conductivity** : Conductance of a solution containing 1 g-equivalent of an electrolyte dissolved in V cm³ of the solution.
 $\Lambda_{eq} = \frac{\kappa \times 1000}{\text{Normality}}$; Unit : $S \text{ cm}^2 \text{ eq}^{-1}$
- **Molar conductivity** : Conductance of a solution containing 1 mole of an electrolyte dissolved in V cm³ of the solution.
 $\Lambda_m = \frac{\kappa \times 1000}{\text{Molarity}}$; Unit : $S \text{ cm}^2 \text{ mol}^{-1}$
- **Electrode potential** : Tendency of an electrode to lose or gain electrons when it is in contact with solution of its own ions.
- **Cell potential or EMF of the cell** : The difference between electrode potentials of two half-cells.

Types of Cells

- **Electrochemical cell** : Device used to convert chemical energy of a redox reaction into electrical energy.
- **Electrolytic cell** : Device which uses electricity to bring about a non-spontaneous redox reaction.

Law

- **Faraday's first law** : $W = Zit$
- **Faraday's second law** : $\frac{W_1}{W_2} = \frac{E_1}{E_2}$
- **Kohlrausch's law** : For an electrolyte A_xB_y , $\Lambda_m^0 = x\lambda_a^0 + y\lambda_b^0$ or $\Lambda_m^0 = \lambda_a^0 + \lambda_b^0$

Nernst Equation and Electrochemical Series

- **Nernst equation** : For the reaction :
 $M^{n+} + ne^- \rightarrow M$,
 $E = E^0 - \frac{RT}{nF} \ln \frac{M}{[M^{n+}]}$ or
 $E = E^0 - \frac{0.0591}{n} \log \frac{1}{[M^{n+}]}$ at 298 K
- For concentration cell :
 $E_{cell} = \frac{0.0591}{n} \log \frac{C_2}{C_1}$; $E_{cell} = +ve$ if $C_2 > C_1$
- For a reaction in equilibrium :
 $E_{cell}^0 = \frac{0.0591}{n} \log K$ at 298 K
- **Electrochemical series** : It is the arrangement of electrodes in order of increasing standard reduction potentials.
 - This series helps in comparing the relative oxidizing or reducing powers, relative activities of metals and to predict spontaneity of the redox reaction.

Commercial Cells/Batteries

- **Primary cells** cannot be recharged e.g., dry cell, mercury cell.
- **Secondary cells** can be recharged e.g., lead storage battery, Ni-Cd storage cell.
- **Fuel cells** convert the energy produced during combustion of fuels into electrical energy directly e.g., H_2 - O_2 fuel cell.

Concept Review Chemistry Physical Properties Of Solution

Darrell D. Ebbing



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Basic Concepts of Chemistry, 9e Study Guide and Solutions Manual Leo J. Malone, Theodore O. Dolter, 2012-01-03 The 9th edition of Malone's Basic Concepts of Chemistry provides many new and advanced features that continue to address general chemistry topics with an emphasis on outcomes assessment. New and advanced features include an objectives grid at the end of each chapter which ties the objectives to examples within the sections, assessment exercises at the end of each section and relevant chapter problems at the end of each chapter. A new Math Check allows quick access to the needed basic skill. The first chapter now includes brief introductions to several fundamental chemical concepts and Chapter Synthesis Problems have been added to the end of each chapter to bring key concepts into one encompassing problem. Every concept in the text is clearly illustrated with one or more step-by-step examples. Making it Real essays have been updated to present timely and engaging real-world applications emphasizing the relevance of the material they are learning. This edition continues the end-of-chapter Student Workshop activities to cater to the many different learning styles and to engage users in the practical aspect of the material discussed in the chapter.

Chemistry: Core Concepts, 3rd Edition Allan Blackman, Daniel Southam, Gwendolyn Lawrie, Natalie Williamson, Christopher Thompson, 2024-01-09 The third edition of Chemistry Core Concepts Blackman et al. has been developed by a group of leading chemistry educators for students entering university with little or no background in chemistry. Available as a full-colour printed textbook with an interactive eBook code, this title enables every student to master concepts and succeed in assessment. Lecturers are supported with an extensive and easy-to-use teaching and learning package.

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Ebook: Chemistry: The Molecular Nature of Matter and Change Silberberg, 2015-01-16 *Ebook Chemistry The Molecular Nature of Matter and Change* *General Chemistry Key Concise Review Guide Sixth Edition* Darrell D. Ebbing, 1999

Chemical Reactor Analysis and Applications for the Practicing Engineer Louis Theodore, 2012-09-11 This book's format follows an applications-oriented text and serves as a training tool for individuals in education and industry involved directly or indirectly with chemical reactors. It addresses both technical and calculational problems in this field. While this text can be complimented with texts on chemical kinetics and/or reactor design, it also stands

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