

# KEY CONCEPTS IN CHEMISTRY



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Medical College

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# GENERAL CHEMISTRY

## 1. Mass and number of moles

- 1.1. Atomic mass, atomic masses of isotopes, atomic mass unit, molar mass;
- 1.2. Number of moles and the Avogadro constant;

## 2. Concentration of solutions

- 2.1. Mass percent concentration;
- 2.2. Mole fraction;
- 2.3. Molarity – molar concentration;

## 3. Molecular formula of compounds

- 3.1. Inorganic acids, bases, and salts;
- 3.2. IUPAC nomenclature of salts;
- 3.3. Molecular formula vs. weight percent composition;

## 4. Chemical reactions and stoichiometry

- 4.1. Balancing chemical equation (mass and charge balance);
- 4.2. Typical reactions of inorganic synthesis, analysis and exchange;
- 4.3. Reaction yield;
- 4.4. Limiting reactant;
- 4.5. Reactions with chemical mixtures (alloys, oxides);

## 5. Ideal gas laws

- 5.1. Standard and normal conditions;
- 5.2. Calculations based on the Clapeyron equation;
- 5.3. Isothermal, isobaric and isochoric transformation of gases;

## 6. Chemical equilibrium

- 6.1. Definition and calculation of equilibrium constant;

## 7. Acid-base equilibria in aqueous solution

- 7.1. Auto-ionization of water and pH scale;
- 7.2. Electrolytic dissociation of weak acids and bases (acidity  $K_a$  and basicity  $K_b$  constants);
- 7.3. Dissociation degree;
- 7.4. Poorly soluble electrolytes – solubility product  $K_{so}$ ;

## 8. Oxidation-reduction (redox) reactions

- 8.1. Oxidation numbers, balancing redox equations;
- 8.2. Redox potentials, Nernst equation, and electrochemical series of metals;
- 8.3. Voltaic cell potentials;

## 9. Thermochemistry

- 9.1. Calculations based on Hess law;
- 9.2. Heat of reaction (enthalpy) of formation and combustion;

## 10. Electronic structure of atoms

- 10.1. Periodic table;
- 10.2. Electronic configuration of s- and p-block elements;
- 10.3. Types of chemical bonding, Lewis structure, geometry of molecules;

**Keywords:**

Element, proton, neutron, electron, cation, anion, isotope, atomic mass, atomic mass unit, molar mass, mole, the Avogadro constant, molar concentration, molarity, mass concentration, molar fraction, metals, nonmetals, ionic compounds, salt, IUPAC nomenclature, limiting reactant, solute, solution, yield of reaction, standard and normal conditions, the Clapeyron equation (ideal gas law), density, isothermal transformation, isobaric transformation, isochoric transformation, molecular equation, ionic equation, equilibrium constant K, pH, hydronium ion, hydroxide anion, strong and weak electrolytes, dissociation constant, solubility product, oxidation, reduction, oxidation numbers, galvanic (voltaic) cells, standard redox potentials, hydrogen electrode, exo- and endothermic reactions, Hess's law, reaction enthalpy, enthalpy of formation, enthalpy of combustion, valence shell, valence electrons, ionic bond, covalent bond, polar molecules, electron configuration, s orbitals, p orbitals, d orbitals.

# RECOMMENDED TEXTBOOKS

## GENERAL CHEMISTRY

1. Regular chemistry text books  
(secondary-school level)
2. Dana R. Freeman, William Yu Wang, *Kaplan Essential Review: High School Chemistry*, Paperback, 304 Pages, Published 1999, ISBN-10: 0-684-86821-0 /0684868210, ISBN-13: 978-0-684-86821-9 /9780684868219
3. Peter Atkins, Loretta Jones, Leroy Laverman, *Chemical Principles*, Publisher: W. H. Freeman; 7<sup>th</sup> edition, ISBN-13: 978-1464183959, ISBN-10: 1464183953 (or any other edition)
4. IUPAC basic definitions of chemical properties and quantities:  
<http://goldbook.iupac.org/PDF/goldbook.pdf>
5. IUPAC nomenclature of inorganic compounds:  
[https://www.iupac.org/fileadmin/user\\_upload/databases/Red\\_Book\\_2005.pdf](https://www.iupac.org/fileadmin/user_upload/databases/Red_Book_2005.pdf), pages 68 – 83
6. Sample chemistry tests:  
<http://www.univer360.com/entrance-exam-topicssamples.html>