

GENERAL AND ANALYTICAL CHEMISTRY

Nataly Kucherenko

Fall Semester

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Office Hours: By appointment

Short description:

1. Introduction:

Basic structure of the atom, Atomic number, Mass number, Isotopes, amu, Atomic mass, Avogadro's number, Mole concept, Basic view of the Periodic Table. Chemical equations and stoichiometric calculations.

2. Electronic Structure of the Atom:

- I. The emission spectrum of the Hydrogen atom, Bohr's model for Hydrogen atom.
- II. Quantum Mechanics Principles, Wave properties of the electron, Schrodinger Equation, Wave function - ψ , The Hydrogen Atomic Orbitals.

3. Multielectron Atoms and Periodic Properties:

Pauli exclusion principle, Hund's rule, The Aufbau process, Penetration and Shielding, Ionization Energy, Atomic and Ionic Radius, Electron Affinity, Electronegativity.

4. Chemical Bonding:

- I. The Ionic Bond, Physical Properties of Ionic Compounds, Born-Haber Cycle, Lattice Energy.
- II. The Covalent Bond, Lewis Structures, The Octet rule, Formal charge, Resonance, Polar Covalent Bonds, Dipole Moment, Molecular geometry, VSEPR Theory, Valence Bond Theory, Hybridization of Atomic Orbitals, Molecular Orbitals Theory.

6. Gases:

- I. The Ideal behavior of gases and the Ideal Gas Laws, R – the universal gas constant.
- II. Non-Ideal Gases, Compressibility, The Van der Waals Equation.

5. Intermolecular forces:

Van der Waals Interactions, London forces, Hydrogen bonds, Melting and Boiling points, Water properties, Hydrophilic and Hydrophobic interactions.

7. Solutions and Concentration Units:

Definition of Solution, Solvent and Solute, Concentration units; Weight Percent, ppm, Mole Fraction, Molarity.

8. Chemical Equilibrium:

Reversible processes, Q – The Reaction Quotient, Equilibrium Constant, K_p and K_c , Le Chatelier's Principle, Quantitative calculations.

9. Insoluble salts and complex ions:

Solubility, Solubility Product Constant, The Common Ion Effect, Fractional Precipitation. Coordination number, Ligands, Chelating agents, Central ion, K_d – dissociation constant.

10. Acids and Bases:

Phenomenology of acids and bases, Arrhenius and Lowry-Bronsted definitions, Self-Ionization of water, Strong Acids and Bases, Weak Acids and Bases, K_w , K_a , K_b , pH and pOH scale, Neutralization reactions, Hydrolysis of Salts, Buffer Solutions, Titration and Titration Curves, Polyprotic Acids, Indicators, Lewis Acids.

11. Oxidation-Reduction (redox) Reactions:

Definition of Oxidizing and Reducing agents, Oxidation States, Balancing Oxidation-Reduction Equations.

Bibliography:

General Chemistry 8th edn., R.H. Petrucci, W.S. Harwood and F.G. Herring. Prentice Hall, New Jersey 2002.

General Chemistry 10th edn., R.H. Petrucci, F.G. Herring, J.D. Madura, C. Bissonnette. Pearson, Toronto 2011.

Assessment* :

Minor assignments:

NA.

Midterm:

Bi-weekly home quiz on Moodle, 15% of the final grade.

Final requirement:

In-class exam, 85% of the final grade

Participation:

No grade on participation.

Attendance:

Attendance is mandatory. Students are permitted a maximum of three absences. Students who do not meet the attendance requirements will be considered not to have fulfilled the obligations of the course.

Academic conduct:

Plagiarism is taken extremely seriously. Any instance of academic misconduct which includes: submitting someone else's work as your own; failure to accurately cite sources; taking words from another source without using quotation marks; submission of work for which you have previously received credit; working in a group for individual assignments; using unauthorized materials in an exam and sharing your work with other students, will result in failure of the assignment and will likely lead to further disciplinary measures.

Additional requirements: TBD

* Please note that if distance learning is required, the assessment procedure, modes of assessment and weightings may be changed.