Questions for the final Chemistry BSc Exam

1.
A.) The Bohr model of the atom. The structure of the electron shells. The quantum mechanical model of the atom.
B.) Electrolytes, reactions in aqueous solutions.
C.) Saturated hydrocarbons: bonding, sp^3 hybridization, nomenclature, physical and chemical properties.

2.
A.) Acid base titrations, titration curves. Titration of weak acid with a strong base, titration of multiprotic acids and basis.
B.) The structure of coordination compounds (complexes), nomenclature, types of isomerism.
C.) Alkyl halides, characterization of the halogen-carbon bond, preparation, chemical reactions, most important halogenated hydrocarbons.

3.
A.) History and significance of the periodic table. Periodic changes in the chemical and physical properties of the elements.
B.) General characterization of metals. Conductors, semiconductors. Metallic lattices.
C.) Unsaturated hydrocarbons: bonding, sp^2 and sp hybridization, nomenclature, reactivity.

4.
A.) Structure of the nucleus: mass defect, nuclear reactions, radioactivity. Applications of radioactive isotopes, nuclear power.
B.) Secondary chemical bonds.
C.) Industrial and biological significance of the most relevant unsaturated hydrocarbons (polymerization, isoprenoids, steroids, carotenoids).

5.
A.) The role of side reactions and complex formation processes in analytical chemistry. Stability products, apparent equilibrium constants. Complexometric titrations.
B.) Primary chemical bonding forces. Covalent, ionic and metallic bonds.
C.) Aromatic hydrocarbons, aromaticity, Hückel's rule. Electrophilic aromatic substitutions.

6.
A.) Quantum chemical theories of chemical bonding (VB, LCAO-MO, MO). Description of the hydrogen molecule ion and the hydrogen molecule.
B.) Types of dissociation. Degree of dissociation, equilibrium constant of dissociation.
C.) Five-membered heterocycles with one and two heteroatoms. Electronic structure, chemical properties and biological importance of heteroaromatic compounds.

7.
A.) Redox equilibria, redox titration curves. Iodometry, permanganometry.
B.) Characterization of alkali metals, their biological roles. Oxides, peroxides and superoxides of alkali and alkaline earth metals.
C.) Six-membered heterocycles with one and two heteroatoms. Electronic structure, chemical properties and biological importance of heteroaromatic compounds.

8.
A.) Principles of thermodynamics: physical properties, state functions. The laws of thermodynamics.
B.) General characterization and biological significance of transition metals.
C.) Bonding in alcohols, phenols and ethers. Physical and chemical properties. Reactions, preparation methods. Biological significance, most important compounds in this group.

9.
A.) Potentiometry and electrodes used in analytical chemistry..
B.) Hydrogen. Covalent and ionic hydrides.
C.) Carbonyl compounds: electronic structure of the carbonyl group, keto-enol tautomerism, significant reactions, compounds and biological significance.

10.
A.) Comparison of the general properties of gases, liquids and solids.
B.) General characterization of the elements in the boron group. Properties of their compounds.
C.) Physical and chemical properties of carboxylic acids and their interpretation based on the electronic structure. Most important carboxylic acids and their biological significance.

11.
A) Conductometric titrations.
B.) General characterization of the elements in the carbon group. Allotropes.
C.) α-Substituted carboxylic acids, di- and polycarboxylic acids.

12.
A.) Optical atomic spectroscopy. Atomic absorption, emission methods in atom spectroscopy.
B.) General characterization and biological significance of alkaline earth metals
C.) Carboxylic acid derivatives, their preparation and biological significance (lipids, phospholipids).

13.
A.) Phase changes in on-component systems. Phase diagrams of pure substances: triple point, critical point. Vapor pressure, Clapeyron equation, Clausius-Claperon equation.
B.) Elements of the nitrogen group and their compounds.
C.) Carbonic acid derivatives, their preparation, reactions and biological significance.

14.
A.) Thermodynamics of mixing. Partial molar quantities, chemical potential, Ideal and real mitures. Phase equilibria in multicomponent systems, the phase rule.
B.) General characterization of the iron group elements and their compounds. Biological significance of iron.
C.) α-Amino acids, peptides, proteins and their biological significance.

15.
A.) Principles and practice of molecular spectroscopy: ultraviolet and visible spectrohptometry.
B.) General characterization of copper group elements and their compounds. Biological role of copper.
C.) Esters of inorganic acids and their practical importance.

16.
A.) Principles of electrophoresis. its instrumentation and most important applications.
B.) Oxygen and its compounds: metal oxides, nonmetal oxides, anhydrides.
C.) Organometallic compounds. Electronic structure, reactivity (*e.g*. organic Mg, Na, Li compounds).

17.
A.) Reaction kinetics: rate of reaction, rate equation, molecularity, elementary reactions. Temperature dependence of the rate constant, Michaelis-Menten kinetics.
B.) General characterization of halogens. Analytical significance of halides.
C.) Organic sulfur compounds. Electronic structure, reactivity and significance in therapy and biological processes (biological methylation, acetyl coenzyme A).

18.
A.) Principles and practice of gas chromatography.
B.) Oxides and oxoacids of sulfur. Sulfides and their significance in analytical chemistry.
C.) Aliphatic and aromatic nitro compounds. Electronic structure, preparation, properties, significance.

19.
A.) Principles and practice of liquid chromatography.
B.) Elements and compounds in the zinc group. Biological role of zinc.
C.) Amines. Electronic structure, reactivity, preparation, basicity.

20.
A.) Chemical equilibria, factors that influence the equilibrium constant, van't Hoff equation, Le Chatelier’s principle.
B.) Elements and compounds in the chromium and manganese groups.
C.) Amines of biological significance: alkaloids, drugs and hormones.

21.
A.) Structure of electrolyte solutions, Debye-Hückel theory, mean activity coefficient, ionic strength. Conduction in electrolytes, Kohlrausch laws.
B.) Aluminum and its compounds.
C.) Simple carbohydrates, sugars, glycosides.

22.
A.) Principles and practice of titrations based on precipitation reactions. Titrating solutions and end point detection methods.
B.) Bonding theories in coordination chemistry. Valance bond theory, ligand field theory.
C.) Complex carbohydrates (disaccharides, polysaccharides), biological energy storage and their structural roles.

23.
A.) Electrode potential, Nernst equation. Types of electrodes, principles of their operations. Electrolysis and the Faraday laws.
B.) Osmotic pressure and its biological significance.
C.) Heterocycles in nucleic bases. Nucleic acids.

24.
A.) Calibration for concentration determination. Working curves in analytical chemistry, the method of least squares.
B.) Boiling point elevation, freezing point depression, practical importance of these phenomena.
C.) Phenomenon of optical activity, its measurements and biological significance.