PROGRAM
of Admission Exam in Chemistry

1. Subject and tasks of chemistry. The role of chemistry among the natural sciences.
2. Atomic-molecular science. Molecules. Atoms. Constancy of the composition of the substance. Relative atomic and molecular mass.
3. The law of conservation of mass, its significance in chemistry. A mole is a unit of quantity of a substance. Molar mass. Avogadro's number.
4. The state of the nuclei of atoms of various chemical elements of the 1st, 2nd, 3rd and 4th periods of the periodic system. Isotopes.
5. Periodic law of chemical elements of D.I. Mendeleev. Distribution of electrons in atoms of elements of the first four periods. Small and large periods, groups and subgroups. Characteristics of individual chemical elements of the main subgroups based on their position in the periodic table and the structure of their atom. The importance of the periodic law for understanding the scientific picture of the world, the development of science and technology.
6. Chemical element, simple substance, complex substance, chemical formulas. Calculation of the mass fraction of a chemical element in a substance using its formula.
7. Types of chemical bonds: covalent (polar, non-polar), ionic, hydrogen, metallic. Examples of connections with connections of different types. Valency and oxidation state.
8. Types of chemical reactions: reactions of connection, decomposition, substitution, metathesis. Redox reactions. (Determination of stoichiometric coefficients in the equations of redox reactions with the method of electronic balance). Standard potentials for redox reactions. A range of standard electrode potentials. Electrolysis of solutions and melts. Thermal effect of chemical reactions.
9. Rate of chemical reactions. Dependence of speed on the nature of the reacting substances, concentration, temperature. Catalysis. Reversibility of chemical reactions. Chemical equilibrium and the condition for its displacement.
10. Solutions. Solubility of substances. The dependence of the solubility of substances on nature of substance, temperature, pressure. Thermal effect during dissolution. Concentration of solutions.
11. Electrolytic dissociation. Degree of dissociation. Strong and weak electrolytes. Ion metathesis reactions. Electrolytic dissociation of acids, alkalis and salts.
12. Oxides: acidic, basic, amphoteric. Methods for obtaining and properties of oxides.
13. Bases, methods of their preparation and properties. Alkalis, their preparation, properties and application.
14. Acids, properties, methods of production. Neutralization reactions.
15. Salts. Composition and properties. Hydrolysis of salts.
16. Hydrogen. Chemical and physical properties. Interaction with oxygen, oxides metals, organic substances. The use of hydrogen as an environmentally friendly fuel and raw material for the chemical industry.
17. Oxygen. Chemical and physical properties. Allotropy. Use of oxygen. Oxygen cycle in nature.
18. Water. Chemical and physical properties. Crystal hydrates. Protection of water bodies from pollution.
19. Chlorine. Chemical and physical properties. Reactions with inorganic and organic substances. Production of chlorine in industry. Chlorine compounds.
20. Halogens. General characteristics of halogens. Halogen compounds in nature, their applications.
21. Carbon subgroup. General characteristics of elements of group IV, the main subgroup. Chemical and physical properties. Carbon and its allotropic forms.
22. Carbon compounds. Oxides (II, IV), carbonic acid and its salts.
23. Silicon. Silicon compounds in nature, their use in technology.

24. Oxygen subgroup. General characteristics of the main subgroup of group VI. Sulfur, her chemical and physical properties. Sulfur compounds: hydrogen sulfide, sulfur oxides. Sulfuric acid, its properties, chemical bases of production.
25. General characteristics of the elements of the main subgroup of group V. Nitrogen. Chemical and physical properties. Nitrogen compounds: ammonia, ammonium salts, nitrogen oxides, nitric acid, its salts (chemical and physical properties). Ammonia production. Application of ammonia, nitric acid and its salts.
26. Phosphorus. Its allotropic forms. Chemical and physical properties. Phosphorus oxide (V), phosphoric acid and its salts. Phosphorus fertilizers.
27. Metals. Position in the periodic table. Features of the structure of their atoms. Metal connection. Characteristic chemical and physical properties. Corrosion of metals.
28. Alkali metals. General characteristics based on position in the periodic table of Mendeleev. Sodium and potassium compounds in nature, their use. Potash fertilizers.
29. General characteristics of the elements of the main subgroups of groups II and III. Calcium, its compounds in nature. Water hardness and ways to eliminate it.
30. Aluminum. Characteristics of aluminum and its compounds. Amphotericity of aluminum. Application of aluminum and its alloys.
31. Characteristics of iron, oxides, hydroxides, salts of iron (II and III). Natural iron compounds. Iron alloys – cast iron and steel. Application of iron alloys and compounds.
32. Metallurgy. Metals in modern technology. Chemical basics of industrial metal production. Blast furnace production of cast iron (chemistry).
33. Copper, silver. Copper (I) and (II) oxides, silver (I) oxide. Copper(II) hydroxide. Silver and copper salts. Compounds of silver and copper.
34. Zinc. Zinc oxides. Zinc hydroxide and its salts.
35. Chromium. Chromium (II), (III) and (VI) oxides. Hydroxides and salts of chromium (II) and (III). Chromates and dichromates (VI). Complex compounds of chromium (III).
36. Manganese. Manganese (II) and (IV) oxides. Manganese (II) hydroxide and salts. Potassium manganate and permanganate.
37. Basic principles of the theory of chemical structure A.M. Butlerov. Dependence of the properties of substances on the chemical structure. Isomerism. The electronic nature of chemical bonds in molecules of organic compounds, methods of breaking bonds, the concept of free radicals.
38. Homologous series of saturated hydrocarbons (alkanes), their electronic spatial structure (sp^3-hybridization). Methane. Nomenclature of alkanes, their chemical and physical properties. Cycloalkanes. Saturated hydrocarbons in nature.
39. Ethylene hydrocarbons (alkenes). Homologous series of alkenes. Double bond. σ- and π-bonds, sp^2-hybridization. Physical properties. Isomerism of the hydrocarbon skeleton and the position of the double bond. Nomenclature. Chemical properties. Application of hydrocarbon dehydrogenation. Application of ethylene hydrocarbons. Diene hydrocarbons, their structure, chemical properties and use. Natural rubber, its structure and properties.
40. Acetylene. Triple bond, sp-hybridization. Homologous series of acetylene. Chemical and physical properties. Use of acetylene. Obtaining it using the carbide method and from methane.
41. Benzene. Its electronic structure. Chemical properties. Industrial production and use of benzene. The concept of pesticides.
42. The relationship between saturated, unsaturated and aromatic hydrocarbons.
43. Natural sources of hydrocarbons: natural gas and its associated petroleum gases, coal. Fractional distillation of oil. Cracking. Catalytic reforming of petroleum products. Environmental protection during oil refining.
44. Monohydric and polyhydric alcohols. Their structure and chemical properties. Isomerism. Nomenclature of alcohols. Chemical properties of alcohols. The use of methyl and ethyl alcohols. Medical and biological significance of alcohols. The toxicity of alcohols. Genetic relationship between hydrocarbons and alcohols.

45. Phenol. Structure, physical properties. Chemical properties of phenol. Environmental protection from industrial waste containing phenol.
46. Aldehydes, their structure and chemical properties. Preparation and use of formic and acetaldehydes.
47. Carboxylic acids. Homologous series of saturated monobasic acids, their structure. Carboxyl group, mutual influence of the carboxyl group and hydrocarbon radical. Chemical and physical properties of carboxylic acids. Acetic, higher carboxylic acids - palmitic, stearic, oleic acids. Obtaining and use of carboxylic acids in medicine
48. Esters. Structure, production by esterification reaction. Chemical properties. Fats in nature, their structure and properties. Synthetic detergents, their meaning. Protecting the environment from pollution with synthetic detergents.
49. Glucose. Its structure, chemical properties, role in nature. Sucrose and its hydrolysis. Starch and cellulose. Their structure, chemical properties, role in nature. Application of cellulose and its derivatives. The concept of artificial fibers.
50. Amines as organic bases. The structure of the amino group. Interaction of atoms with water and acids. Aniline. Preparation of aniline from nitrobenzene, practical application of aniline.
51. Amino acids. Structure, chemical features, isomerism of amino acids. Meaning in nature and application in medicine. Synthesis of peptides, their structure.
52. Proteins. Structure and properties of proteins. Advances in the study and synthesis of proteins. Importance in the microbiological industry.
53. Nucleic acids. The structure of nucleotides. The principle of complementarity in the structure of the DNA double helix. The role of nucleic acids in cell life.
54. General concepts of the chemistry of high-molecular compounds: monomer, polymer, structural unit, degree of polymerization, average molecular weight. Polymerization, polycondensation. Linear and branched structures of polymers. Dependence of the properties of polymers on their structure.