

MEDICAL CHEMISTRY & DENTAL MATERIALS: EXAM QUESTIONS

General and Physical Chemistry

1. Structure of atom – basic principles. Models of atom. Basic laws of chemistry.
2. Chemical bonds and bond energy. Electronegativity of elements – significance for properties of bonds in molecules. Covalent bond. Polarity of covalent bond. Ionic bond.
3. Intermolecular forces. Hydrogen bonds. Coordination compounds – examples and significance.
4. Solutions – general properties. Expressions of solution composition and concentration.
5. Solubility of substances. Solubility product.
6. Water as a solvent and medium. Properties of water. Hydrophilic and hydrophobic substances. Eluotropic series of solvents.
7. Thermochemistry. The laws of thermochemistry. Exothermic and endothermic reactions.
8. The laws of thermodynamics. Entropy, enthalpy and free energy.
9. Chemical reactions. Types of chemical reactions, examples. Kinetics of chemical reactions. Effects of reaction conditions on reaction rates. Catalysts.
10. Chemical equilibrium. The equilibrium constant.
11. Electrolytes, electrolytic dissociation. Ionic strength of solutions – calculation, significance.
12. Theories of acids and bases. Protolytic reactions. Dissociation constant. Dissociation of acids and bases.
13. pH – expressions of acidity or alkalinity of solutions. Autoprotolysis of water. Ionic product of water.
14. Hydrolysis of salts. pH of salt solutions. Ampholytes and polyelectrolytes. Isoelectric point. Electrophoresis.
15. Buffers – theory and importance in chemistry and biology. Calculation of pH of buffers. The Henderson-Hasselbalch equation.
16. Reactions of acids and bases. Neutralization. Titration curves.
17. Oxidation and reduction. Redox potential, electrochemical series of metals.
18. Dispersion systems – properties, classification. Lyophilic and lyophobic colloids – examples and properties. Colloid solutions – general properties.
19. Diffusion, dialysis and ultrafiltration. Osmotic phenomena – importance in chemistry. Donnan equilibrium.
20. Processes at phase boundaries. Chromatography – kinds, significance for medicine.
21. Crystals. Crystal lattice. Structure of crystals.

Inorganic Chemistry

1. Macro- and microbiogenic elements.
2. Group Ia elements (H, Li, Na, K, Rb, Cs, Fr) – medically and toxicologically relevant elements and compounds, their significance.
3. Hydrogen and its medically and toxicologically relevant compounds.
4. Water – properties and significance.
5. Sodium and potassium, their important compounds – biological and medical significance.
6. Group IIa elements (Be, Mg, Ca, Sr, Ba, Ra) – medically and toxicologically relevant elements and compounds, their significance.
7. Group IIIa elements (B, Al, Ga, In, Tl) – medically and toxicologically relevant elements and compounds, their significance.
8. Group IVa elements (C, Si, Ge, Sn, Pb) – medically and toxicologically relevant elements and compounds, their significance.

9. Carbon and its important inorganic compounds.
10. Group Va elements (N, P, As, Sb, Bi) – medically and toxicologically relevant elements and compounds, their significance.
11. Phosphorus and nitrogen, their compounds – biological and medical significance.
12. Sulfur and selenium, their important compounds – biological and medical significance.
13. Oxygen and its medically relevant compounds.
14. Halogens (F, Cl, Br, I, At) and their medically and toxicologically relevant compounds. Fluoride compounds in dentistry.
15. Group Ib metals (Cu, Ag, Au) and their compounds – medical and toxicological significance.
16. Group IIb elements (Zn, Cd, Hg) and their compounds – medical and toxicological significance.
17. Group VIIIb metals (Fe and Pt triads) and their compounds – medical and toxicological significance.
18. Cadmium and mercury – medical and toxicological significance.
19. Medically and toxicologically relevant elements and compounds of groups IVb – VIIIb elements (Ti, Zr, V, Nb, Ta, Cr, Mo, W, Mn, Tc).
20. Oxides of carbon, nitrogen and sulfur – biological, medical and toxicological significance.
21. Inorganic acids significant from the medical and toxicological point of view.

Organic Chemistry and Essentials of Biochemistry

1. Chemical bonds in molecules of organic compounds. Bond σ and π . Basic types of organic reactions, examples.
2. Isomerism of organic compounds. Formulas of organic compounds.
3. Hydrocarbons – classification. Aliphatic and cyclic hydrocarbons.
4. Aromatic hydrocarbons (arenes).
5. Alcohols and phenols.
6. Aldehydes and ketones. Acetals and hemiacetals. Ethers.
7. Thioalcohols, significance of thiol group, examples of other organic compounds of sulfur that are significant from medical point of view.
8. Carboxylic acids – properties, classification, significant representatives.
9. Functional and substitution derivatives of carboxylic acids. Anhydrides of organic and inorganic acids. Esters of organic and inorganic acids.
10. Amines. Nitro compounds. Halogenated hydrocarbons.
11. Amino acids – properties, classification, and biological significance.
12. Heterocyclic compounds. Heterocycles containing nitrogen. Pyrimidines and purines. Heterocycles containing oxygen and sulfur.
13. Proteins. Peptidic bond – origin, properties, significance. Structure of proteins, bonds that stabilize protein structure.
14. Saccharides – properties, structure, classification, significance.
15. Vitamins – classification, basic structure, significance.
16. Lipids – properties, classification, structure, significance. Sterols and terpenes.
17. Nucleosides and nucleotides. Nucleic acids.
18. Examples of natural and synthetic substances used in medicine. Alkaloids.
19. Surface-active substances (soaps, tensides). Examples of substances acting as disinfectants.
20. Polymers natural and synthetic, classification according to structure.
21. Polymerization, polycondensation, polyaddition.

At the exam a student draws a triplet of questions, containing one question from each category.

September 25th 2024

Prof. MUDr. Tomáš Zima, DrSc., MBA
Head of the institute