

Zagadnienia i pytania na egzamin dyplomowy dla studentów biotechnologii w j. angielskim

The problems and questions for graduate exams for biotechnology students

Basic and Analytical Chemistry

1. The naturally occurring isotopes and radioactive isotopes and their use in chemistry, and medicine.
2. Explain using proper examples how the electron structures of the elements are related to the position of the element in the s-,p-,d-,f-block of the periodic table.
3. Short characteristic of the types of chemical bonds. Try to summarize how the physical properties of substances are associated with different types of bonding.
4. Shapes of molecules and ions. Basing on the VSEPR theory and hybridization predict the shapes for the following molecules: SiF_4 , PCl_3 , H_2S , NF_3 , SF_6 .
5. Theories of acids and bases in chemistry – examples.
6. Strong and weak acid and bases. The equilibrium constants between weak acid or base and water. The pH scale, acid – base titrations.
7. Buffer solution in chemistry and biochemistry. Describe the composition of a buffer solution and explain its action.
8. The oxidation and reduction processes in chemistry and biology. Redox equation, some common oxidizing agents and reducing agents - examples.
9. The characteristics of the metals as reductants- a redox reactivity series. Metals-acid reactions.
10. Describe the methods of preparation of water solution of substances of defined concentrations. The most common units of concentrations, the methods of calculations, processes of conversion of one concentrations into other.

Organic chemistry

1. Reactivity of Alkanes, Alkenes, Alkynes and Dienes.
2. Aromatic Compounds. A General Mechanism of Electrophilic Aromatic Substitution. Effect of Substituents on Reactivity and Orientation.
3. Conformations of Alkanes and Cycloalkanes. Chiral Molecules. Nomenclature of Enantiomers: The (R,S) System.
4. Alcohols and Ethers. Physical Properties and Reactivity.

5. Ionic Reactions. Nucleophilic Substitution and Elimination Reactions of Alkyl Halides.
6. Aldehydes and Ketones. Nucleophilic Addition to the Carbonyl Group.
7. Keto and Enol Tautomers. Aldol Reactions.
8. Carboxylic Acids and Their Derivatives. Nucleophilic Substitution at the Acyl Group.
9. Aliphatic and Aromatic Amines. Physical Properties and Reactivity.
10. Acids and Bases in Organic Chemistry
11. Carbohydrates – Classification, Structural Formulas and Reactions of Monosaccharides, Glycoside Formation, Mutarotation.
12. Amino Acids. Structure and Names. Amino Acids as Dipolar Ions. Formation of Peptide Group.

Physical Chemistry

1. The first law of thermodynamics.
2. The second law of thermodynamics.
3. Hess's law and Kirchhoff's law (standard enthalpy changes, standard integral energy changes).
4. Criterion of phase equilibrium (the phase rule).
5. A one-component phase diagram (for example CO₂ or H₂O).
6. Definition of equilibrium constants for ideal and real system. The law of mass action.
7. Effect of temperature on chemical equilibrium (K) - van't Hoff isobar.
8. The rates of reactions.
9. Reaction order. First-order reaction.
10. Effect of temperature on reaction rates (the Arrhenius equation).
11. Surface tension. Surface active substance.
12. Electrolysis. The Faraday's law. Electrode processes.
13. An electrochemical cell. The Nernst equation.

Microbiology

1. The role of bacterial biofilms in medicine and biotechnology.
2. Quorum sensing in bacterial biofilms.
3. Eradication of bacterial biofilms by antibiotics.
4. Ureolytic activity of bacteria – mechanism and its regulation.

5. The virulence factors of *Proteus mirabilis* and *Pseudomonas aeruginosa*.
6. The importance of microorganisms in wastewater treatment.
7. Identification of anti-bacterial antibodies using peptides.
8. Diagnosis of rheumatoid arthritis by using the tools of biotechnology.
9. Antibacterial therapies in cystic fibrosis.
10. Analysis of antibiotics diffusion – cultivation and biophysical methods.
11. Immunoserological techniques in diagnosis of human diseases.
12. Spectroscopy techniques in microbiological diagnosis.

Biochemistry

1. Protein structure and function
2. Sugars and complex carbohydrates
3. Nucleotides and nucleic acids
4. Lipids, membranes and cellular transport
5. Enzymes and biological catalysis
6. Glycolysis and gluconeogenesis
7. Citric acid cycle
8. Pentose phosphate pathway
9. Electron transport and oxidative phosphorylation
10. Lipid and fatty acid catabolism
11. Amino acid metabolism
12. Nucleotide metabolism

Genetic

1. Principles of Mendelian inheritance
2. Sex determination and sex linkage
3. Pedigree analysis
4. Linkage and mapping in eukaryotes
5. Genetic variation
6. DNA structure and function
7. Chromosome replication and cell division
8. Human genome
9. Multifactorial inheritance

10. Variation in genetically complex traits

11. Hardy-Weinberg equilibrium and population genetics

12. Recombinant DNA technology