Exam composition

The exam consists of an online test (30 questions) randomly chosen from the self-control tests on the corresponding topics and a written part (4 questions).

Composition of the online test:

1. Calculation of the mass fraction of a substance in a solution
2. Calculation of the osmolarity of solutions
3. Isotonic, hypertonic, hypotonic solutions
4. Thermodynamic functions
5. Entropy
6. Standard enthalpy of combustion and formation
7. Factors affecting reaction rate
8. Half-life period
9. The influence of temperature and pressure on the shift of equilibrium
10. Calculation of Kc and concentrations of the compounds
11. Acidity and basicity of the compounds
12. Qualitative determination of pH in solutions
13. Calculation of pH in solutions of salts
14. Calculation of pH in solutions of strong acids and bases; in solutions of acidic salts
15. Calculating the pH of a buffer solution
16. Composition of amino acid buffer systems
17. systems. Oxidants and reductants
18. Calculation of the EMF of a reaction
19. The relation between solubility and Ksp. The order of ions precipitation from a solution
20. Comparison of the stability of complex compounds
21. Surface active, inactive and active compounds. The effect on surface tension
22. Comparison of surface tension of solution
23. Adsorption (types, definitions
24. Ionic adsorption
25. Classification of colloidal surfactants
26. Double-layer electrical potentials and micelle constituents
27. Structure of micelles
28. Formation of emulsions
29. Coagulation threshold, coagulating capacity of electrolytes
30. Amino acid composition of proteins, pI

written part

Question 1

Topic (main types of organic reactions) - 10 points (2 points for each reaction and 2 points for the names).

Complete the reaction equations, name the resulting product:

1. S_R, A_E or S_E reaction

2. S_N or E reaction

3. A_N or S_N reaction for carbonyl compounds and their derivatives

4. Reaction of a hetero- or polyfunctional compound, or oxidation-reduction reaction**.**

Question

Topic: Carbohydrates - 10 points

a) (8 points) Draw a scheme of cyclo-oxo tautomerism of a monosaccharide or its derivative (two cyclic and acyclic forms). Indicate the glycosidic hydroxyl group. Write the formula of the epimer of this monosaccharide at C-2 (C-3, C-4) and name it;

or:

Draw the formula of a disaccharide: maltose, isomaltose, cellobiose, lactose, or sucrose; indicate and name the glycosidic bonds; determine whether this disaccharide is reducing or not, capable of cyclo-oxo tautomerism or not;

or:

Draw the structure of a fragment of a polysaccharide: cellulose, amylose, amylopectin, or glycogen, indicate and name the glycosidic bonds.

b) (2 points) Write the reaction equation of:

reduction of monosaccharides, oxidation of aldoses under various conditions, alkylation, acylation, phosphorylation, formation and hydrolysis of glycosides, hydrolysis of monosaccharide phosphates, transformations through the enediol form.

Name the resulting products.

Question 3

Topic: (nucleotides) – 10 points.

a) (8 points) Write the structural formula of the given nucleotide and the reaction equation for its complete hydrolysis. Specify the N-glycosidic, ester and, if any, high-energy bonds.

b) (2 points) Write the reaction equation for:

tautomeric transformations of nucleic bases and hydroxypurines; hydroxylation of hypoxanthine and xanthine, deamination of a nucleic base with nitrous acid or hydrolytic deamination.

Name the resulting products.

Question 4

Topic (lipids) – 10 points.

a) (8 points) Write the formula of a lipid (triacylglycerol, phosphatidylcholine, phosphatidylserine, phosphatidylcolamine, cerebroside, ceramide, sphingomyelin). Indicate the class of a lipid and its groups. Specify and name the types of bonds present in the lipid (amide, glycoside or ester). Write the equation of the reaction of acidic or alkaline hydrolysis of this lipid. Draw the configuration of one of the unsaturated acids, name it using ω-nomenclature.

b) (2 points) Write the equation of the reaction:

hydrogenation, peroxidation, epoxidation of an unsaturated higher fatty acid, the reaction of β-oxidation of a saturated fatty acid, the reaction of wax formation or L-phosphatidic acid, lipid hydrolysis.

Name the resulting products.

Question 5

Topic (amino acids, peptides) – 10 points.

a) (7 points) Write the formula of a tripeptide. Specify the peptide bonds, N- and C-terminus of the peptide. Write the equation of the reaction of acidic or alkaline hydrolysis of this peptide upon heating or in vivo under the action of the corresponding peptidases (pH≈7).

b) (3 points) Write the equations of two reactions involving α-amino acids:

(esterification, aliphatic and aromatic hydroxylation, oxidative and non-oxidative deamination, elimination, transamination, decarboxylation, alkylation, acylation, chelation, interaction with aldehydes, oxidation of NAD+ or FAD, oxidation of cysteine, aldol cleavage and hydrolysis). Name the resulting products.

Ticket example

1. Write down the reactions, name the products:

a) $CH_3CH_2CH_2CH{=}CH_2 \xrightarrow{O_2/X^{\cdot}}$

b) $CH_3\underset{\underset{OH}{|}}{C}HCH_2COOH \xrightarrow[-H_2O]{H^+/t}$

c) $CH_3\text{-}C(=O)CH_3 + C_2H_5NH_2 \xrightarrow{H^+}$

d) $HOOCCH_2\underset{\underset{OH}{|}}{C}HCOOH + НАД^- \xrightarrow{-НАДН;-H^+}$

Write down the mechanism of the (1) reaction

2. Draw the structure of maltose, indicate the glycosidic bond, write the equation for its hydrolysis.

b) Write down the equation:

galactosamine + $CH_3C(O)SCoA \longrightarrow$

3. a) Draw the structural formula of guanosine-2',3'-diphosphate and its hydrolysis. Specify N-glycosidic and ester bonds.

b) Write down the equation:

$$\text{guanine} + H_2O \xrightarrow[\text{deamination}]{}$$

4. a) Write the formula of sphingomyelin containing a fragment of linoleic acid, indicate the amide and ester groups. Write the reaction equation for the hydrolysis of this lipid in an alkaline medium.

b) Write down the equations:

$$\beta\text{-hydroxystearoyl-CoA} \xrightarrow{NAD^+} A;\ A + HSCoA \xrightarrow[\text{cleavage}]{\text{retro-aldol}}$$

5. a) Write the formula of tripeptide Val-Thr-Phe. Indicate the peptide bonds, N- and C-terminus of the peptide. Write the reaction equation for the hydrolysis of this peptide in HCl solution.

b) Write down the equation:

