

МИНИСТЕРСТВО ЗДРАВООХРАНЕНИЯ РЕСПУБЛИКИ БЕЛАРУСЬ
УЧРЕЖДЕНИЕ ОБРАЗОВАНИЯ
«ГОМЕЛЬСКИЙ ГОСУДАРСТВЕННЫЙ МЕДИЦИНСКИЙ УНИВЕРСИТЕТ»

Кафедра общей и биоорганической химии

Е. Г. ТЮЛКОВА, А. К. ДОВНАР

БИООРГАНИЧЕСКАЯ ХИМИЯ. СБОРНИК ТЕСТОВ

Пособие
для студентов учреждений высшего образования,
обучающихся по специальности «Лечебное дело» на английском языке

BIOORGANIC CHEMISTRY. COLLECTION OF TESTS

Гомель
ГомГМУ
2026

УДК 577.1(076.3)(075.8)111
ББК 28.072.51я73432.1
Т98

Рецензенты:

доктор биологических наук, доцент,
профессор кафедры биологии учреждения образования
«Гомельский государственный университет имени Ф. Скорины»

А. Г. Цуриков;

***кафедра общей и биорганической химии
учреждения образования «Гродненский государственный
медицинский университет»***

Тюлькова, Е. Г.

Т98 Биоорганическая химия. Сборник тестов = Bioorganic chemistry. Collection of tests : пособие / Е. Г. Тюлькова, А. К. Довнар. – Гомель : ГомГМУ, 2026. – 1 файл (объем 592 КБ). – Систем. требования: IBM-совместимый компьютер; Windows XP и выше; ОЗУ 512 Мб; CD-ROM 8-х и выше. – Загл. с этикетки диска. – Текст: электронный. ISBN 978-985-588-511-6.

Пособие содержит тестовые задания с ответами по классификации и номенклатуре органических соединений; пространственному строению органических молекул и стереоизомерии; взаимному влиянию атомов в органической молекуле; кислотно-основным свойствам органических соединений и реакционной способности углеводов, альдегидов, кетонов, карбоновых кислот и их функциональных производных; поли- и гетерофункциональным соединениям, а также биологически активным гетероциклическим соединениям; биополимерам – полисахаридам, пептидам, белкам, нуклеиновым кислотам, их структурным компонентам, липидам, низкомолекулярным биорегуляторам. Тесты могут быть использованы как для контроля качества усвоения учебного материала, так и для закрепления и систематизации знаний во время лабораторных занятий и самостоятельной работы студентов.

Пособие разработано на основе учебной программы учреждения образования по учебной дисциплине «Биоорганическая химия» для студентов 1 курса специальности 7-07-0911-01 «Лечебное дело» с обучением на английском языке

**УДК 577.1(076.3)(075.8)111
ББК 28.072.51я73432.1**

Утверждено и рекомендовано к изданию научно-методическим советом учреждения образования «Гомельский государственный медицинский университет» 19 июня 2025 г., протокол № 7.

ISBN 978-985-588-511-6

© Учреждение образования
«Гомельский государственный
медицинский университет», 2026

CONTENT

Introduction.....	4
1. Fundamentals of the structure and reactivity of organic compounds	5
2. Biologically important heterofunctional compounds.....	21
3. Biopolymers and their structural components. Bioregulators.....	31
Answers.....	49
References.....	51

INTRODUCTION

«Bioorganic Chemistry» is an academic discipline of the chemical module, which contains systematic scientific knowledge about substances and their transformations, accompanied by changes in composition, structure and properties. This knowledge is necessary to understand the basics of the development of new drugs, as well as the physico-chemical methods of qualitative and quantitative analysis of biological fluids, solutions of drugs and biopolymers.

The purpose of the discipline “Bioorganic Chemistry” is to develop basic professional competence for solving diagnostic, research and other tasks of professional activity based on knowledge of the spatial structure and chemical properties of biologically important classes of organic compounds involved in life processes, as a basis for understanding the essence of metabolism and its regulation at the molecular level.

The objectives of the academic discipline “Bioorganic Chemistry” are to form students’ scientific knowledge about the theoretical foundations and factors determining the reactivity of organic compounds; the structure and properties of organic compounds of biologically important classes; the relationship between the spatial structure and mechanisms of functioning of biologically active molecules; environmental aspects of the action of organic compounds; application of organic compounds in medicine; the skills and abilities necessary to evaluate the chemical properties of natural and synthetic organic compounds and predict their behavior in biological environments.

The structure of the test collection is presented in the following sections: «Fundamentals of the structure and reactivity of organic compounds», «Biologically important heterofunctional compounds», «Biopolymers and their structural components. Bioregulators».

1. FUNDAMENTALS OF THE STRUCTURE AND REACTIVITY OF ORGANIC COMPOUNDS

Choose one correct variant of answer

1. According to the functional groups, 4-hydroxy-3-methoxybenzaldehyde is...

Variants of answer:

- a) phenol, ether, ester;
- b) ether, ketone, heterocyclic compound;
- c) aldehyde, phenol, ether;
- d) ester, alcohol, aldehyde;
- e) alcohol, ketone, carboxylic acid.

2. What type of compounds does 2-isopropyl-5-methylcyclohexan-1-ol belong to according to the structure of the hydrocarbon skeleton?

Variants of answer:

- a) heterocyclic, saturated;
- b) alicyclic, carbocyclic;
- c) heterocyclic, unsaturated;
- d) unsaturated, aromatic;
- e) saturated, heterocyclic.

3. A covalent σ -bond is a bond that ...

Variants of answer:

- a) is formed by the lateral overlap of non-hybrid p-orbitals; it does not polarize;
- b) has a lower bond energy than the π -bond; a single bond is shorter than a double bond;
- c) is formed by the lateral overlap of non-hybrid p-orbitals; it is easily polarized;
- d) is formed by the axial overlap of atomic orbitals; the overlap region is located on the axis connecting the nuclei of atoms, and is not destroyed when part of the molecule rotates around the bond axis;
- e) is formed due to the lateral overlap of hybrid atomic orbitals.

4. A covalent π -bond is a bond that ...

Variants of answer:

- a) is formed by the overlap of atomic orbitals end-to-end; overlap region is located on the axis connecting the nuclei; has a low bond energy;
- b) does not break down when a part of the molecule is rotated around the bond axis; the double bond is shorter than the triple bond;
- c) is formed by lateral overlap of non-hybrid p-atomic orbitals; it is more easily polarized than the σ -bond;

- d) is not polarized and stronger than the σ -bond;
- e) is formed due to the axial overlap of hybrid atomic orbitals.

5. In the composition of all compounds of which series are there no sp^2 -hybrid atoms?

Variants of answer:

- a) propanoic acid, butanal, colamine;
- b) butane, aniline, propane;
- c) ethyl alcohol, xylitol, phenol;
- d) glycerol, butane, ethanol;
- e) benzene, pyridine, pyrrole.

6. Which series of compounds all contain pyridine nitrogen?

Variants of answer:

- a) nicotinic acid, pyrimidine, purine;
- b) n-ethoxyaniline, aniline, imidazole;
- c) pyrimidine, pyrrole, cordiamine;
- d) pyrazole, purine, furan;
- e) methanol, ethanal, pyrrolidine.

7. Which series of compounds all contain pyrrole nitrogen?

Variants of answer:

- a) pyridine, glycerol, colamine;
- b) imidazole, purine, pyrazole;
- c) purine, methylamine, arginine;
- d) nitrobenzene, acetic acid, hexamethylenediamine;
- e) propane, methanol, benzene.

8. In all compounds of which series is there a π,π -conjugation?

Variants of answer:

- a) benzene, acrolein, ethanol;
- b) pentadiene-1,4, propanal, propanoic acid;
- c) pentadiene-1,3, benzene, isoprene;
- d) propanal, valeric acid, phenol;
- e) methanal, acetic acid, cyclohexane.

9. In all compounds of which series is there a p,π -conjugation?

Variants of answer:

- a) ethylene glycol, glycerol, xylitol;
- b) pyridine, pyrimidine, furan;
- c) pyrrole, acetic acid, methoxyethene;
- d) propene-2-al, purine, thiophene;
- e) methane, ethene, benzene.

10. Which series of compounds are all aromatic?

Variants of answer:

- a) naphthalene, phenanthrene, purine;
- b) cyclooctatetraene, cyclopentane, azulene;
- c) pyrrole, cyclohexane, cyclopropane;
- d) cyclohexatriene-1,3,5, cyclopentane, menthol;
- e) ethane, toluene, hexane.

11. In all compounds of which series the functional group exhibits negative resonance effect ($-R$)?

Variants of answer:

- a) butene-2-al, propenoic acid;
- b) ethanol, propanone;
- c) glycerol, ethylene glycol;
- d) acetone, 4-methylaniline;
- e) propane, methanol.

12. In all compounds of which series the functional group exhibits ONLY negative inductive effect ($-I$)?

Variants of answer:

- a) phenol, glycerol;
- b) ethanedioic acid, propanone;
- c) methylphenyl ketone, butanedioic acid;
- d) acetic acid, ethylene glycol;
- e) butane, methanoic acid.

13. All functional groups of which substance are electron withdrawing groups?

Variants of answer:

- a) 2-hydroxybenzoic acid;
- b) 4-aminobenzenesulfonic acid;
- c) 2,3-dihydroxypropanal;
- d) 4-hydroxy-3-methoxybenzaldehyde;
- e) phenol.

14. All functional groups of which compound are electron donating groups?

Variants of answer:

- a) 2-isopropyl-5-methylcyclohexan-1-ol;
- b) para-aminobenzaldehyde;
- c) 2-isopropyl-5-methylphenol;
- d) succinic acid;
- e) formic acid.

15. Newman's projection formulas are used to show...

Variants of answer:

- a) different conformations of the molecule;
- b) the chemical structure of the compound;
- c) various structural isomers;
- d) the configuration of the molecule;
- e) a quantitative set of atoms in a molecule.

16. The staggered and the eclipsed conformations of butan-2-ol have different energies because they differ in ...

Variants of answer:

- a) configuration and conformation;
- b) Van der Waals and torsional strains;
- c) angle and torsional strains;
- d) chemical structure and configuration;
- e) torsional strain and molecular formula.

17. The 1,3-dimethylcyclohexane molecule has the maximum energy reserve in the chair conformation when:

Variants of answer:

- a) both methyl groups are in equatorial positions;
- b) both methyl groups are in axial positions;
- c) the first methyl group is in the axial position, and the second is in equatorial position;
- d) the first methyl group is in the equatorial position, and the second is in the axial position;
- e) the three methyl groups are in axial positions.

18. Which series of compounds are all chiral?

Variants of answer:

- a) glycine, ethanol, ethane;
- b) butan-1-ol, heptane, propanone;
- c) D-ribose, D-xylose, threonine;
- d) butan-2-ol, hexane, propanal;
- e) aniline, methane, propene.

19. Which series of compounds are all chiral?

Variants of answer:

- a) 2-aminoethan-1-ol, glycine;
- b) menthol, ethane-1,2-diol;
- c) thiophene, furan;
- d) D-glucose, α -alanine;
- e) benzene, aniline.

20. What is the specific angle of rotation of the plane of polarized light at 25 degrees Celsius has a racemic mixture?

Variants of answer:

- a) 0.0;
- b) +5.2;
- c) -8.3;
- d) -5.2;
- e) +8.3.

21. How many stereoisomers can 2-aminopropanoic acid have?

Variants of answer:

- a) 2;
- b) 1;
- c) 4;
- d) 3;
- e) 5.

22. In which series are all reactionary centers acidic?

Variants of answer:

- a) -O-; -S-;
- b) -Cl; -Br;
- c) O-H; C-H;
- d) -N=; -S-;
- e) -I; -F.

23. Which compound has the most acidic properties?

Variants of answer:

- a) oxalic acid;
- b) phenol;
- c) formic acid;
- d) glycerol;
- e) acetic acid.

24. In which series are all reactionary centers basic?

Variants of answer:

- a) proton, -S-;
- b) quaternary nitrogen atom, -NH-;
- c) -SH, proton;
- d) -O-, -N=;
- e) -OH, quaternary nitrogen atom.

25. Electrophilic particles are...

Variants of answer:

- a) H-atom, Br-anion;
- b) proton, Br-cation;

- c) hydride ion, H-atom;
- d) hydroxide ion, Cl-anion;
- e) O-atom, NH₃.

26. In which series are only the nucleophilic particles listed?

Variants of answer:

- a) HOH, hydroxide ion;
- b) proton, Br-cation;
- c) hydride ion, H-atom;
- d) Br-cation, alkoxide ion;
- e) Cl-cation, proton.

27. Which compound has the most acidic properties?

Variants of answer:

- a) acetic acid;
- b) propanoic acid;
- c) 2,2,2-trichloroethanoic acid;
- d) 2-methylpropanoic acid;
- e) valeric acid.

28. Which compound has the weakest acidic properties?

Variants of answer:

- a) ethanol;
- b) ethanamine;
- c) phenol;
- d) ethanethiol;
- e) para-nitrophenol.

29. Which compound has the strongest basic properties?

Variants of answer:

- a) 2-aminoethan-1-ol;
- b) dimethylamine;
- c) methylamine;
- d) pyridine;
- e) aniline.

30. Reactions where two atoms or a group of atoms leave a substrate molecule, resulting in the formation of a multiple bond, are called...

Variants of answer:

- a) substitution reactions;
- b) elimination reactions;
- c) addition reactions;
- d) synchronous (coordinated) reactions;
- e) isomerization reactions.

31. What particles are formed during the homolytic type of bond cleavage?

Variants of answer:

- a) carbocations;
- b) nucleophiles;
- c) free radicals;
- d) electrophiles;
- e) isopropyl cation.

32. What particles can be formed during the heterolytic type of bond cleavage?

Variants of answer:

- a) carbocation and nucleophile;
- b) electrophile and proton;
- c) nucleophile and free radical;
- d) carbanion and hydride ion;
- e) carbocation and proton.

33. Which series includes only nucleophilic reagents?

Variants of answer:

- a) NH_2 -anion, NO_2 -cation;
- b) methyl-cation, proton;
- c) H_2O , ROH ;
- d) Br -cation, chlorine-anion;
- e) isobutyl cation, bromine cation.

34. Which series includes only electrophilic reagents?

Variants of answer:

- a) proton, nitrolyl cation;
- b) NH_3 , R-NH_2 ;
- c) Br -anion, H_2O ;
- d) Cl -anion, ROH ;
- e) ethyl cation, hydride ion.

35. Reactions in which the leaving group in the substrate molecule is replaced by the incoming group are called...

Variants of answer:

- a) elimination reactions;
- b) addition reactions;
- c) redox reactions;
- d) substitution reactions;
- e) hydration reactions.

36. What is the general formula of alkanes?

Variants of answer:

- a) $C_n H_{2n}$;
- b) $C_n H_{2n-2}$;
- c) $C_n H_{2n-6}$;
- d) $C_n H_{2n+2}$;
- e) $C_n H_{2n+1}$.

37. Alkane molecules have covalent bonds between carbon and hydrogen atoms, which can be characterized as follows...

Variants of answer:

- a) polar, multiple;
- b) double, single;
- c) sigma, single;
- d) delocalized, polar;
- e) non-polar, triple.

38. What is the typical reaction mechanism of alkanes?

Variants of answer:

- a) S_R ;
- b) A_E ;
- c) S_E ;
- d) A_N ;
- e) S_N .

39. The regioselectivity of radical substitution reactions in alkanes upon irradiation of a mixture of 2-methylpentane with bromine is expressed in the predominant formation of...

Variants of answer:

- a) 2-bromo-4-methylpentane;
- b) 3-bromo-2-methylpentane;
- c) 1-bromo-2-methylpentane;
- d) 2-bromo-2-methylpentane;
- e) 2-bromo-3-methylpentane.

40. The chemical bonds between carbon and hydrogen atoms in unsaturated hydrocarbon molecules can be characterized as follows.....

Variants of answer:

- a) simple and multiple covalent bonds;
- b) ionic;
- c) sigma-covalent bonds only;
- d) multiple bonds only;
- e) double bonds only.

41. What is the name of citric acid according to the substitutive IUPAC nomenclature?

Variants of answer:

- a) 3-hydroxy-3-carboxypentanoic acid;
- b) 3-hydroxy-3-carboxypentanedioic acid;
- c) 2-hydroxy-2-carboxypentanedioic acid;
- d) 3-carboxy-4-hydroxypentanedioic acid;
- e) 4-hydroxy-2-carboxypentanedioic acid.

42. In which series are all the reactions in which alkenes and dienes can participate listed?

Variants of answer:

- a) elimination, substitution;
- b) formation of salts, elimination;
- c) addition, polymerization;
- d) polymerization, substitution;
- e) addition, substitution.

43. What products are formed during the hydration of alpha-, beta-unsaturated acids?

Variants of answer:

- a) alpha-hydroxycarboxylic acids;
- b) beta-hydroxycarboxylic acids;
- c) gamma-hydroxycarboxylic acids;
- d) alpha, beta-dihydroxycarboxylic acids;
- e) gamma-dihydroxycarboxylic acids.

44. What is the product of oxidation of 2-methylbut-2-ene with an aqueous solution of potassium permanganate without heating?

Variants of answer:

- a) 2-methylbutan-2-ol
- b) 2-methylbutane-2,3-diol;
- c) 2-methylbutane-1,2-diol;
- d) 2-methyl-2,3-diethoxybutane;
- e) 3-methylpropanol.

45. Qualitative (test) reactions to unsaturated hydrocarbons include both reactions of the series:

Variants of answer:

- a) with molecular bromine in an aqueous solution and potassium permanganate in an aqueous solution;
- b) with molecular chlorine, polymerization reaction;
- c) with ozone followed by reductive hydrolysis;

- d) with hydrogen bromide, hydration reaction;
- e) with nitric acid, isomerization reaction.

46. All compounds of which series can be identified by discoloration of bromine water?

Variants of answer:

- a) pentane, cyclobutane;
- b) pentyne-1, cyclopentane;
- c) pent-2-ene, penta-1,3-diene;
- d) cyclopentane, propane;
- e) methane, cyclopropane.

47. In which series both compounds are arenes?

Variants of answer:

- a) cyclohexane, phenanthrene;
- b) cycloocta-1,3,5,7-tetraene, toluene;
- c) anthracene, naphthalene;
- d) ortho-xylene, cyclopentane;
- e) benzene, methane.

48. In which series do all the characteristics correspond to the aromatic core of arenes?

Variants of answer:

- a) sp^2 -hybridization of each carbon atom, flat cycle;
- b) sp -hybridization of carbon atoms, acyclic structure of the carbon skeleton;
- c) sp^3 -hybridization of carbon atoms in the cycle, thermodynamic instability;
- d) the number of π -electrons corresponds to the Hückel's rule, an acyclic type of conjugated system;
- e) sp^3 -hybridization of each carbon atom, cyclic structure of the carbon skeleton.

49. What is the typical reaction mechanism of arenes?

Variants of answer:

- a) S_E ;
- b) S_N ;
- c) S_R ;
- d) A_E ;
- e) E.

50. In which series are all compounds oxidized by potassium permanganate in a sulfuric acid medium when heated?

Variants of answer:

- a) benzene, polystyrene;
- b) isopropylbenzene, chlorobenzene;
- c) toluene, isopropylbenzene;

- d) styrene, nitrobenzene;
- e) xylene, cyclobutane.

51. What is the common external sign of the oxidation of homologues and other alkyl derivatives of benzene by potassium permanganate in a sulfuric acid medium when heated?

Variants of answer:

- a) formation of a brown precipitate;
- b) the release of gas;
- c) change in the pH of the solution;
- d) discoloration of the solution;
- e) formation of a blue precipitate.

52. In which series do all the characteristics describe ethyl alcohol?

Variants of answer:

- a) secondary, unsaturated;
- b) polyhydroxy, secondary;
- c) monohydroxy, primary;
- d) unsaturated, monohydroxy;
- e) monohydroxy, aromatic.

53. What is the name of menthol according to the substitutive IUPAC nomenclature?

Variants of answer:

- a) cyclohexanol;
- b) 2-isopropyl-5-methylcyclohexan-1-ol;
- c) 1,2-dihydroxybenzene;
- d) 1,4-dihydroxybenzene;
- e) xylene.

54. Glycerol is...

Variants of answer:

- a) aromatic alcohol, hydroquinone;
- b) trihydroxy alcohol, propane-1,2,3-triol;
- c) polyhydroxy alcohol, xylitol;
- d) monohydroxy, tertiary alcohol;
- e) unsaturated alcohol, methanol.

55. In which series are all the reactionary centers of aldehydes listed?

Variants of answer:

- a) only electrophilic and nucleophilic;
- b) electrophilic, basic, alpha-CH-acidic;
- c) only nucleophilic and basic;

- d) only nucleophilic and alpha-CH-acidic;
- e) nucleophilic, electrophilic, beta-OH-acidic.

56. Which reaction center(s) is absent in aromatic aldehydes, where the oxo group is directly bound to the benzene ring?

Variants of answer:

- a) electrophilic;
- b) electrophilic and basic;
- c) alpha-CH-acidic;
- d) alpha-CH-acidic and basic;
- e) beta-OH-acidic.

57. Reactions that are not typical for oxo compounds include...

Variants of answer:

- a) nucleophilic addition-elimination reactions;
- b) reactions involving the alpha-CH-acidic center;
- c) nucleophilic substitution reactions;
- d) reduction reactions;
- e) oxidation reactions.

58. The product of the addition of water to the aldehyde is...

Variants of answer:

- a) unstable dihydric alcohol;
- b) ketone;
- c) acetal;
- d) hemi-acetal;
- e) carbonic acid.

59. What is the final product of the reaction of ethanal with excess methanol in an acidic medium?

Variants of answer:

- a) 1,1-dimethoxyethane;
- b) 1,1-diethoxymethane;
- c) methyl ethanoate;
- d) ethyl methanoate;
- e) methylpropane.

60. What is the reaction mechanism of oxo compounds with amines?

Variants of answer:

- a) A_N-E ;
- b) S_R ;
- c) S_N ;
- d) A_E ;
- e) E.

61. In which series can primary alcohols be obtained by reducing all oxo compounds?

Variants of answer:

- a) acetone, butanal;
- b) methylpropyl ketone, propanal;
- c) acetophenone, propanone;
- d) propanal, benzaldehyde;
- e) methane, hydroquinone.

62. In which series does copper (II) hydroxide in an alkaline solution NOT oxidize all oxo compounds when heated?

Variants of answer:

- a) formaldehyde, acetaldehyde;
- b) 3-methylpentan-2-one, propanone;
- c) propanal, butanone;
- d) 2-methylbutanal, propanal;
- e) methanal, butanal.

63. When benzaldehyde is oxidized by Tollens' reagent, the following products are formed:

Variants of answer:

- a) benzyl alcohol and red-orange precipitate;
- b) benzyl alcohol and "silver mirror";
- c) benzoic acid and "silver mirror";
- d) benzoic acid and "copper mirror";
- e) citric acid and "silver mirror".

64. As a result of the disproportionation of formaldehyde in the basic medium, the following products are formed:

Variants of answer:

- a) methanol and water;
- b) formic acid and water;
- c) methanol, methanoic acid and hydrogen;
- d) methanol and salt of formic acid;
- e) acetic acid and carbon dioxide.

65. Carboxylic acids, depending on the number of carboxyl groups ($-COOH$) contained in them, are classified into...

Variants of answer:

- a) dicarboxylic, heterocyclic, aliphatic;
- b) aliphatic, monocarboxylic, oxo amino acids;
- c) monocarboxylic, dicarboxylic, tricarboxylic;
- d) aromatic, tricarboxylic, heterocyclic;
- e) saturated, unsaturated, aromatic.

66. Monocarboxylic aliphatic acids include all acids from the following series:

Variants of answer:

- a) ethanedioic, malonic;
- b) ethanoic, butyric;
- c) benzoic, caproic;
- d) succinic, valeric;
- e) fumaric, terephthalic.

67. Dicarboxylic aliphatic acids include all acids from the following series:

Variants of answer:

- a) butyric, valeric;
- b) oxalic, caproic;
- c) isophthalic (benzene-1,3-dicarboxylic), malic;
- d) malonic, glutaric;
- e) acetic, citric.

68. Functional derivatives of carboxylic acids are all compounds of the following series:

Variants of answer:

- a) acetic anhydride, acyl halide;
- b) methyl acetate, benzyl chloride;
- c) ethanoyl chloride, ethyl alcohol;
- d) ethyl chloride, acetamide;
- e) acetone, benzaldehyde.

69. Functional derivatives of carboxylic acids are all compounds of the following series:

Variants of answer:

- a) acetophenone, butanoyl chloride;
- b) benzyl chloride, benzyl alcohol;
- c) ethyl benzoate, methoxyethane;
- d) isopropyl acetate, acetamide;
- e) aniline, ethyl acetate.

70. The structure of the carboxyl group corresponds to...

Variants of answer:

- a) sp^2 -hybridization of a carbon atom and one of the oxygen atoms, sp^3 -hybridization of the second oxygen atom;
- b) sp^2 -hybridization of carbon and two oxygen atoms; a three center p, π -conjugated system is formed;
- c) absence of a conjugated system, sp -hybridization of the carbon atom;
- d) π, π -conjugated system, planar configuration;
- e) p, π -conjugated system, sp -hybridization of the second oxygen atom.

71. Which reactionary center is responsible for the relatively strong acidic properties of carboxylic acids?

Variants of answer:

- a) NH-acidic;
- b) alpha-CH-acidic;
- c) OH-acidic;
- d) electrophilic;
- e) nucleophilic.

72. When carboxylic acid is dissolved in water...

Variants of answer:

- a) the medium is neutral;
- b) $\text{pH} > 7$;
- c) $\text{pH} < 7$;
- d) first the neutral medium, then the basic one;
- e) first the basic medium, then the neutral one.

73. Both substances from the following series will react with an alkali solution at room temperature:

Variants of answer:

- a) methyl benzoate and aniline;
- b) methylamine and propanal;
- c) benzoic acid and phthalic (benzene-1,2-dicarboxylic) acid;
- d) methylphenyl ether and toluene;
- e) acetone and methanol.

74. Both reactions from the following series can be used to obtain functional derivatives of carboxylic acids:

Variants of answer:

- a) electrophilic addition, radical substitution;
- b) acylation, nucleophilic substitution;
- c) nucleophilic addition, elimination;
- d) electrophilic substitution, nucleophilic addition;
- e) electrophilic substitution, radical substitution.

75. What is the product of the reaction of butanoic acid with ammonia during prolonged heating?

Variants of answer:

- a) butanoic acid amide;
- b) ethylbutanoate;
- c) butan-1-amine;
- d) butanoic acid anhydride;
- e) butanal.

76. On which reactionary center of functional derivatives of carboxylic acids will the hydrolysis reaction take place?

Variants of answer:

- a) alpha-CH-acidic;
- b) NH-acidic;
- c) electrophilic;
- d) nucleophilic,
- e) beta-OH-acidic.

77. Which substance has the greatest reactivity to SN-reactions?

Variants of answer:

- a) acetic anhydride;
- b) ethanamide;
- c) propylethanoate;
- d) propyl thioester of ethanoic acid;
- e) ethanoic acid.

78. Both acids from the following series can participate in the decarboxylation reaction when heated:

Variants of answer:

- a) acetic, lactic;
- b) propanoic, stearic;
- c) butanoic, acetic;
- d) oxalic, malonic;
- e) palmitic, methanoic.

2. BIOLOGICALLY IMPORTANT HETEROFUNCTIONAL COMPOUNDS

Choose one correct variant of answer

1. Both molecules from the following series have an NH-acidic reactionary center:

Variants of answer:

- a) furan, thiophene;
- b) pyrimidine, indole;
- c) pyrrole, imidazole;
- d) pyridine, thiophene;
- e) furan, naphthalene.

2. The acidic properties of heterocyclic compounds are confirmed by their reactions with...

Variants of answer:

- a) acids;
- b) bases;
- c) acyl halides;
- d) alcohols;
- e) ethers.

3. Which of the listed heterocyclic compounds does not form salts with acids?

Variants of answer:

- a) imidazole;
- b) pyridine;
- c) pyrrole;
- d) pyrimidine;
- e) purine.

4. Which of the listed N-containing heterocyclic compounds has the strongest basic properties?

Variants of answer:

- a) pyrrole;
- b) pyrimidine;
- c) imidazole;
- d) pyridine;
- e) purine.

5. Which aromatic heterocyclic compounds are called acidophobic?

Variants of answer:

- a) compounds that do not interact with either acids or bases;
- b) compounds that form stable salts when treated with strong acids;

- c) compounds that become “resinous” due to the destruction of their aromatic structure when treated with strong acids;
- d) compounds that form salts when treated with strong bases;
- e) compounds that interact with both acids and bases.

6. Tautomerism is possible for heterocyclic compounds if the following two reaction elements are simultaneously present in their molecules:

Variants of answer:

- a) acidic and basic;
- b) two acidic;
- c) two basic;
- d) electrophilic and nucleophilic;
- e) electrophilic and two nucleophilic.

7. Tautomeric transformations are possible for all heterocyclic compounds of the following series:

Variants of answer:

- a) imidazole, barbituric acid;
- b) furan, xanthine;
- c) pyridine, uric acid;
- d) pyrrole, thiophene;
- e) pyrrole, indole.

8. Lactim-lactam tautomerism is characteristic of all heterocyclic compounds of the following series:

Variants of answer:

- a) thiophene, pyrrole;
- b) adenine, indole;
- c) cytosine, uric acid (2,6,8-trioxopurine);
- d) imidazole, pyridine;
- e) skatole, nicotinic acid.

9. Keto-enol tautomerism is characteristic of the following heterocyclic compound:

Variants of answer:

- a) uric acid;
- b) adenine;
- c) imidazole;
- d) barbituric acid;
- e) pyrrole.

10. Pyrrole is an aromatic compound because...

Variants of answer:

- a) the molecule is a cyclic π,π -conjugated system, all atoms in the cycle are sp-hybridized;

- b) the molecule is cyclic, the cycle is not planar; it contains $4n+2 = 5\pi$ electrons;
- c) the molecule is cyclic, the cycle is planar, there is no conjugation; it contains $4n+2 = 4\pi$ electrons;
- d) the molecule is cyclic, planar, fully conjugated and has $4n+2 = 6\pi$ electrons due to the fact that the nitrogen atom contributes its lone pair of electrons to the π -system;
- e) the molecule is a π,π -conjugated system with an open chain of conjugation, all atoms in cycle are sp^2 -hybridized.

11. Electrophilic substitution reactions proceed at maximum rate and under the mildest conditions in all compounds of the following series:

Variants of answer:

- a) benzene and its homologues;
- b) alkanes and cycloalkanes;
- c) pyrrole, thiophene;
- d) pyridine, nicotinic acid;
- e) alkenes, alkadienes.

12. Which series contains only pyrimidine nitrogenous bases, which are structural components of nucleic acids?

Variants of answer:

- a) adenine, thymine;
- b) uric acid, cytosine;
- c) uracil, thymine;
- d) guanine, adenosine;
- e) furan, adenine.

13. Which series contains only purine nitrogenous bases, which are structural components of nucleic acids?

Variants of answer:

- a) uracil, cytosine;
- b) guanine, adenine;
- c) thymine, adenosine;
- d) cytosine, thymidine;
- e) pyrrole, uracil.

14. What is the most stable tautomeric form of uracil included in the structure of nucleic acids?

Variants of answer:

- a) enol;
- b) lactim;
- c) lactam;
- d) amino-lactam;
- e) keto.

15. What is the most stable tautomeric form of cytosine included in the structure of nucleic acids?

Variants of answer:

- a) lactim;
- b) lactam;
- c) keto;
- d) amino-lactam;
- e) enol.

16. What is the most stable tautomeric form of guanine included in the structure of nucleic acids?

Variants of answer:

- a) lactim;
- b) keto;
- c) enol;
- d) amino-lactam;
- e) lactam.

17. Which compound is heterofunctional?

Variants of answer:

- a) oxalic acid;
- b) lactic acid;
- c) glycerol;
- d) sorbitol;
- e) benzoic acid.

18. Which of the listed acids is hydroxycarboxylic acid?

Variants of answer:

- a) formic acid;
- b) malic acid;
- c) glyoxylic acid;
- d) acetic acid;
- e) butyric acid.

19. Which statement about hydroxycarboxylic acids is correct?

Variants of answer:

- a) they are polyfunctional compounds;
- b) they are achiral and optically inactive compounds;
- c) they contain only a carboxyl group in the molecules;
- d) all 2-, 3-, 4-, and 5-hydroxycarboxylic acids lose water when heated, although different products are formed;
- e) their molecules contain several carboxyl groups.

20. Which of the listed hydroxycarboxylic acids has the strongest acidic properties?

Variants of answer:

- a) 2-hydroxypropanoic acid;
- b) 3-hydroxy-2-methylpropanoic acid;
- c) 2-hydroxy-3-methylbutanoic acid;
- d) 3-hydroxy-2-isopropylbutanoic acid;
- e) 4-hydroxy-2-methylbutanoic acid.

21. Which of the following reactions is not typical for saturated hydroxycarboxylic acids?

Variants of answer:

- a) oxidation reaction;
- b) esterification reaction;
- c) polymerization reaction;
- d) dehydration reaction;
- e) nucleophilic substitution reaction.

22. When β -hydroxycarboxylic acids are heated, the following usually occurs:

Variants of answer:

- a) cleavage to formation aldehyde and formic acid;
- b) dehydration to form of unsaturated carboxylic acid;
- c) formation of a cyclic diester (lactide);
- d) formation of a cyclic ester (lactone);
- e) hydroxylation reaction.

23. When lactic acid (2-hydroxypropanoic acid) is heated, the following products are formed:

Variants of answer:

- a) acid anhydride and H_2O ;
- b) lactide and H_2O ;
- c) lactam and H_2O ;
- d) diketopiperazine and H_2O ;
- e) unsaturated carboxylic acid and H_2O .

24. Which of the following compounds is oxocarboxylic acid?

Variants of answer:

- a) tartaric acid;
- b) pyruvic acid;
- c) oxalic acid;
- d) acetic acid;
- e) benzoic acid.

25. Derivative of *p*-aminobenzoic acid is...

Variants of answer:

- a) salicylic acid;
- b) anesthesine;
- c) pyrrole;
- d) streptocide;
- e) aspirin.

26. Derivative of salicylic acid is...

Variants of answer:

- a) aspirin;
- b) sodium acetate;
- c) anesthesine;
- d) uracil;
- e) etazole.

27. Derivative of sulfanilic acid is...

Variants of answer:

- a) novocaine;
- b) morphine;
- c) streptocide;
- d) aspirin;
- e) anesthesine.

28. The basic properties of heterocyclic compounds are confirmed by their reactions with...

Variants of answer:

- a) bases;
- b) acids;
- c) hydrocarbons;
- d) halogenated hydrocarbons;
- e) acyl halides.

29. Choose the correct statement about the structure of pyridine.

Variants of answer:

- a) the compound is a π -insufficient π,π -conjugated aromatic system;
- b) the compound is a p,π -conjugated system with open chain of conjugation;
- c) the compound is a superaromatic p,π -conjugated system;
- d) the lone electron pair of pyridine nitrogen participates in the formation of a delocalized π -bond in a π,π -conjugated aromatic system;
- e) pyridine is not an aromatic compound because it does not meet all the criteria for aromaticity.

30. As a result of which reaction nicotinic acid (pyridine-3-carboxylic acid) can be obtained:

Variants of answer:

- a) reduction of pyridine;
- b) oxidation of 4-methylpyridine;
- c) acylation of pyridine;
- d) oxidation of 3-methylpyridine;
- e) oxidation of pyrrole.

31. Specify the correct statement regarding acetoacetic acid.

Variants of answer:

- a) it is a hydroxy acid;
- b) exists in solution in tautomeric forms;
- c) has optical activity;
- d) enters into electrophilic substitution reactions;
- e) it meets all the criteria for aromaticity.

32. Which of the listed amino acids forms diketopiperazine (cyclic diamide) when heated?

Variants of answer:

- a) 2-aminobutanoic acid;
- b) 3-aminobutanoic acid;
- c) 4-aminobutanoic acid;
- d) 4-amino-2-methylbutanoic acid;
- e) β -aminovaleric acid.

33. Which of the following compounds forms lactide when heated?

Variants of answer:

- a) 2-aminobutanoic acid;
- b) 2-hydroxybutanoic acid;
- c) 2-aminopropanoic acid;
- d) 3-hydroxypropanoic acid;
- e) 3-aminobutanoic acid.

34. Which of the listed keto acids belongs to the “ketone bodies”?

Variants of answer:

- a) pyruvic acid;
- b) acetoacetic acid;
- c) oxaloacetic acid;
- d) α -ketoglutaric acid;
- e) β -ketovaleric acid.

35. Specify the correct statement regarding malic acid.

Variants of answer:

- a) has two chiral centers in the molecule;

- b) malic acid is a monohydroxydicarboxylic acid;
- c) biologically active is D-malic acid;
- d) salts of malic acid are called tartrates;
- e) malic acid is a dihydroxymonocarboxylic acid.

36. Specify the correct statement regarding lactic acid.

Variants of answer:

- a) lactic acid is a monohydroxydicarboxylic acid;
- b) biologically active is D-lactic acid;
- c) biologically active is L-lactic acid;
- d) oxalates are salts of lactic acid;
- e) lactic acid refers to “ketone bodies”.

37. With which of the listed substances can the amino acid $\text{NH}_2\text{-CH}_2\text{-COOH}$ form salts?

Variants of answer:

- a) HCl ;
- b) $\text{C}_2\text{H}_5\text{OH}$;
- c) ethanal;
- d) PCl_5 ;
- e) acetone.

38. Which of the following compounds are characterized by an intramolecular elimination reaction?

Variants of answer:

- a) α -hydroxy acids;
- b) all hydroxy acids;
- c) γ -hydroxy acids;
- d) β -amino acids;
- e) all amino acids.

39. Which of the following compounds is classified as polyfunctional compound?

Variants of answer:

- a) 2-aminoethan-1-ol;
- b) propanol;
- c) propanedioic acid;
- d) 3-hydroxypropanoic acid;
- e) colamine.

40. What is the name of the type of dynamic isomerism in which isomers exist in solution in a state of thermodynamic equilibrium?

Variants of answer:

- a) stereoisomerism;
- b) tautomerism;

- c) isomerism of carbon chain;
- d) interclass isomerism;
- e) isomerism of the position of a multiple bond.

41. Phenobarbital is...

Variants of answer:

- a) 5-phenylbarbituric acid;
- b) 5-ethylbarbituric acid;
- c) 5.5-diethylbarbituric acid;
- d) 5-ethyl-5-phenylbarbituric acid;
- e) 3-methylbarbituric acid.

42. What compound is formed by the interaction of salicylic acid and phenol under certain conditions?

Variants of answer:

- a) sodium salicylate;
- b) methyl salicylate;
- c) phenyl salicylate;
- d) acetylsalicylic acid;
- e) ethyl salicylate.

43. *p*-Aminobenzoic acid exhibits amphoteric properties in reactions with...

Variants of answer:

- a) C_2H_5OH and KOH ;
- b) HCl and $NaOH$;
- c) PCl_5 and CH_3OH ;
- d) NH_3 and PCl_3 ;
- e) ethanol and ethanol.

44. Select the correct statement regarding pyrazole.

Variants of answer:

- a) has an acidic center;
- b) does not have a basic center;
- c) represents a six-membered cycle;
- d) is a carbocyclic compound;
- e) is not an aromatic compound.

45. Which of the following compound is a derivative of isonicotinic acid?

Variants of answer:

- a) cordiamine;
- b) tubazide (isoniazid);
- c) pyridine;
- d) vitamin PP;
- e) barbituric acid.

46. Which of the following types of tautomerism is possible for barbituric acid?

Variants of answer:

- a) amino-imine;
- b) keto-enol;
- c) phototropic;
- d) cyclo-oxo;
- e) all of the above.

47. What type of vitamins do nicotinic acid and nicotinamide belong to?

Variants of answer:

- a) PP;
- b) A;
- c) B₁₂;
- d) D;
- e) C.

48. Tautomeric transformations are possible for the following heterocyclic compound:

Variants of answer:

- a) furan;
- b) pyridine;
- c) pyrrole;
- d) thiophene;
- e) barbituric acid.

49. What are the salts of lactic acid called?

Variants of answer:

- a) lactates;
- b) citrates;
- c) urates;
- d) tartrates;
- e) oxalates.

50. What are the salts of tartaric acid called?

Variants of answer:

- a) lactates;
- b) tartrates;
- c) barbiturates;
- d) pyruvates;
- e) malates.

3. BIOPOLYMERS AND THEIR STRUCTURAL COMPONENTS. BIOREGULATORS

Choose one correct variant of answer

1. The monomers of nucleic acids are:

Variants of answer:

- a) monosaccharides;
- b) nucleotides;
- c) amino acids;
- d) nucleosides;
- e) heterocyclic bases.

2. What products are formed during ribonucleotide hydrolysis at pH=4?

Variants of answer:

- a) heterocyclic nitrogenous base, ribose, phosphoric acid;
- b) ribonucleoside, phosphoric acid;
- c) deoxyribonucleoside, phosphoric acid;
- d) heterocyclic nitrogenous base, ribose;
- e) phosphoric acid, ribose, deoxyribose.

3. What products are formed during deoxyribonucleotide hydrolysis in the basic medium?

Variants of answer:

- a) heterocyclic nitrogenous base, phosphoric acid;
- b) deoxyribonucleoside, phosphate anion;
- c) deoxyribose, phosphate anion;
- d) ribonucleoside, phosphoric acid;
- e) heterocyclic nitrogenous base, deoxyribose, phosphate anion.

4. Hydrolysis of nucleosides occurs in...

Variants of answer:

- a) basic medium;
- b) alcohol solutions;
- c) acidic medium;
- d) concentrated salt solutions;
- e) neutral medium.

5. What type of bonds are mononucleotide units connected in the primary structure of nucleic acids?

Variants of answer:

- a) phosphodiester bonds;
- b) hydrogen bonds;

- c) anhydride bonds;
- d) N-glycosidic bonds;
- e) O-glycosidic bonds.

6. A nucleoside is a pyrimidine or purine nitrogenous base bound to ribose or deoxyribose by...

Variants of answer:

- a) anhydride bond
- b) hydrogen bonding;
- c) phosphodiester bond;
- d) N-glycosidic bond;
- e) ester bond.

7. In DNA, guanine is complementary to...

Variants of answer:

- a) adenine;
- b) thymine;
- c) cytosine;
- d) 6-N-methyladenine;
- e) uracil.

8. In DNA, thymine is complementary to...

Variants of answer:

- a) cytosine;
- b) adenine;
- c) guanine;
- d) hypoxanthine;
- e) uracil.

9. Which of the listed compounds contains macroergic bonds (one bond accumulates about 32 kJ/mol of energy)?

Variants of answer:

- a) ATP;
- b) guanosine;
- c) uridine;
- d) thymidine;
- e) the NAD–NAD-H system.

10. Choose the correct statement regarding adenosine triphosphate (ATP).

Variants of answer:

- a) it is a part of nucleic acids; it is a coenzyme of dehydrogenases;
- b) it is a compartment of NAD;
- c) it is a high-energy triphosphate ester; accumulates and releases chemical energy for various cellular processes;

- d) it is a coenzyme in decarboxylation reactions;
- e) it is a coenzyme in hydroxylation reactions.

11. Oxidative form of nicotinamide adenine dinucleotide (NAD⁺) is...

Variants of answer:

- a) part of nucleic acids, nucleosides;
- b) high-energy triphosphate ester used *in vivo* to provide energy for metabolic needs;
- c) acceptor of hydride ions (H⁻), which oxidizes alcohols to aldehydes or ketones *in vivo*;
- d) cyclic mononucleotide;
- e) donor of hydride ions (H⁻), which reduces aldehydes or ketones to alcohols *in vivo*.

12. D-glucose can be classified as...

Variants of answer:

- a) polysaccharide, glycogen;
- b) monosaccharide, aldohexose;
- c) aldopentose, xylose;
- d) ketohexose, ribulose;
- e) reducing disaccharide.

13. D-fructose can be classified as...

Variants of answer:

- a) ketohexose, a monosaccharide;
- b) disaccharide, lactose;
- c) aldohexose, arabinose;
- d) ketopentose, fructose;
- e) polysaccharide, starch.

14. Maltose can be classified as...

Variants of answer:

- a) monosaccharide (aldohexose);
- b) non-reducing disaccharide;
- c) heteropolysaccharide (heparin);
- d) reducing disaccharide;
- e) homopolysaccharide.

15. Lactose consists of the following residues:

Variants of answer:

- a) β-galactose and α- or β-glucose;
- b) two α-glucoses;
- c) two β-glucoses;

- d) α -galactose and β -glucose;
- e) β -galactose and α - or β -mannose.

16. Sucrose can be classified as:

Variants of answer:

- a) monosaccharide;
- b) reducing disaccharide;
- c) non-reducing disaccharide;
- d) homopolysaccharide;
- e) heteropolysaccharide.

17. Select the correct characteristics of cellulose.

Variants of answer:

- a) reducing disaccharide consisting of α -D-glucofuranose units;
- b) non-reducing disaccharide having α -1,6-glycosidic bonds;
- c) homopolysaccharide with linear structure of macromolecules;
- d) homopolysaccharide with branched structure of macromolecules;
- e) heteropolysaccharide having β -1,6-glycosidic bonds.

18. Monosaccharides are all compounds of the following series:

Variants of answer:

- a) lactose, sucrose;
- b) D-ribose, amylose;
- c) D-mannose, D-fructose;
- d) cellobiose, cellulose;
- e) glycogen, hyaluronic acid.

19. Monosaccharides are all compounds of the following series:

Variants of answer:

- a) chondroitin sulfate, hyaluronic acid;
- b) D-deoxyribose, lactose;
- c) D-glucosamine, D-ribose;
- d) maltose, amylose;
- e) lactose, D-galactose.

20. Which series contains only disaccharides?

Variants of answer:

- a) D-fructose, L-arabinose;
- b) cellobiose, D-galactose;
- c) cellulose, dextran;
- d) sucrose, maltose;
- e) hyaluronic acid, D-mannose.

21. Which series contains only homopolysaccharides?

Variants of answer:

- a) glycogen, cellulose;
- b) starch, D-galactose;
- c) lactose, cellulose;
- d) maltose, amylopectin;
- e) amylose, chondroitin sulfate.

22. Which series contains only reducing disaccharides?

Variants of answer:

- a) D-glucose, D-galactose;
- b) sucrose, amylose;
- c) lactose, maltose;
- d) glycogen, heparin;
- e) D-galactose, cellulose.

23. Non-reducing disaccharide is...

Variants of answer:

- a) D-galactose;
- b) cellobiose;
- c) sucrose;
- d) dextran;
- e) lactose.

24. D-glucose and L-glucose molecules are...

Variants of answer:

- a) diastereomers;
- b) anomers;
- c) enantiomers;
- d) epimers;
- e) homologues.

25. How many tautomeric forms of D-glucose are in tautomeric equilibrium in solution?

Variants of answer:

- a) five;
- b) three;
- c) four;
- d) six;
- e) two.

26. Find the correct information about amylopectin.

Variants of answer:

- a) its macromolecules consist of α -D-glucopyranose und β -D-glucopyranose units;
- b) its macromolecules are linear;

- c) it is a reducing sugar of bacterial origin;
- d) it is branched fraction of starch with α -1,4-glycosidic bonds in the main chain and α -1,6-glycosidic bonds in the branches;
- e) it is a reserve polysaccharide of animal origin.

27. In the amylose chain, the α -D-glucopyranose units are connected by...

Variants of answer:

- a) α -1,3-glycosidic bond;
- b) β -1,4-glycosidic bond;
- c) α -1,3-glycosidic bond;
- d) α -1,4-glycosidic bond;
- e) β -1,3-glycosidic bond.

28. O-glycosides are products of the reaction of monosaccharides with...

Variants of answer:

- a) bromine water;
- b) alcohols (in presence of dry HCl);
- c) acetic anhydride;
- d) nitric acid;
- e) methyl iodide (in the basic medium).

29. What conditions are necessary for the oxidation of D-glucose in the Trommer's test?

Variants of answer:

- a) copper (II) hydroxide, alkaline medium, heating;
- b) diammine silver (I) hydroxide solution, heating;
- c) bromine water;
- d) ethyl alcohol (in presence of dry HCl)
- e) concentrated aqueous solution of sodium hydroxide.

30. D-glucuronic acid is formed as a result of oxidation in the D-glucose molecule of...

Variants of answer:

- a) an aldehyde group;
- b) a primary alcohol group with a preliminary protection of the aldehyde group;
- c) the hydroxyl group of the second carbon atom;
- d) both aldehyde and primary alcohol groups;
- e) hydroxyl groups of the second and third carbon atoms.

31. Which of the following information about O-glycosides is true?

Variants of answer:

- a) they are unstable to the action of dilute alkali solutions;
- b) have only a cyclic structure, hydrolyze in an acidic medium;
- c) their characteristic feature is cyclo-oxo-tautomerism;

d) they are oxidized by Tollens' and Trommer's reagents under certain conditions;

e) they have a linear structure and are hydrolyzed in basic medium.

32. Choose the right information about sucrose.

Variants of answer:

a) its solutions mutarotates;

b) it hydrolyzes in an acidic medium when heated, it is not oxidized by Tollens' and Trommer's reagents;

c) it hydrolyzes in alkaline solutions;

d) it is oxidized by the action of Tollens' and Trommer's reagents.

e) it is a reducing disaccharide.

33. Find the correct information about maltose.

Variants of answer:

a) it consists of α -D-galactopyranose and β -D-glucopyranose residues;

b) it is a reducing disaccharide characterized by cyclo-oxo tautomerism;

c) it is hydrolyzed in an alkaline medium;

d) it is not oxidized by the Tollens' and Trommer's reagents.

e) it is a non-reducing disaccharide.

34. Find the correct information about starch.

Variants of answer:

a) starch has an animal origin; it is a heteropolysaccharide;

b) it is a mixture of amylose and dextran;

c) the final products of its hydrolysis are D-fructose and D-glucose;

d) it is a mixture of amylose and amylopectin; macromolecules consist of α -D-glucopyranose residues;

e) it has a bacterial origin and an unbranched structure.

35. Which of the following information about glycogen is correct?

Variants of answer:

a) it has unbranched macromolecules similar to amylose;

b) glycogen structurally similar to amylopectin, but more branched; it is a source of D-glucose in the human body;

c) it consists of α -D-galactopyranose and glucopyranose residues;

d) it is a reducing homopolysaccharide of plant origin;

e) it has a linear structure; it is a source of vitamin D in the human body.

36. Which of the following information about cellulose is correct?

Variants of answer:

a) it has a branched structure with α -1,4-glycosidic bonds in the main chain and α -1,6-glycosidic bonds in the branches;

b) it consists of β -D-glucopyranose residues connected by β -1,4-glycosidic bonds;

- c) the final products of its hydrolysis are D-galactose and D-glucose;
- d) it is a source of energy for humans;
- e) it has a bacterial origin and a linear structure of macromolecules.

37. An amino acid that can be present in peptides and proteins is.....

Variants of answer:

- a) D-allo isoleucine;
- b) D-serine;
- c) L-valine;
- d) D-alanine;
- e) L-allo isoleucine.

38. Which series contains only essential α -amino acids?

Variants of answer:

- a) asn, trp, ala;
- b) phe, met, lys;
- c) phe, asn, cys
- d) lys, ser, gln;
- e) gly, ser, ala.

39. Which series contains only essential α -amino acids?

Variants of answer:

- a) val, ala, pro;
- b) gly, ser, leu;
- c) val, trp, thr;
- d) cys, glu, asn;
- e) gly, ala, tyr.

40. Which series contains only essential α -amino acids?

Variants of answer:

- a) arg, gly, ile;
- b) ser, ala, gln;
- c) cys, pro, glu;
- d) lys, leu, val;
- e) glu, ser, cys.

41. An amino acid that does not have a chiral center is...

Variants of answer:

- a) glutamine;
- b) glycine;
- c) isoleucine;
- d) arginine;
- e) threonine.

42. Which amino acids have two chiral centers in their molecules?

Variants of answer:

- a) tryptophan, phenylalanine;
- b) proline, asparagine;
- c) isoleucine, threonine;
- d) leucine, lysine;
- e) glycine, alanine.

43. Which series contains only neutral α -amino acids?

Variants of answer:

- a) gly, gln, glu;
- b) leu, val, ala;
- c) arg, ser, lys;
- d) asp, pro, asn;
- e) glu, asp, lys.

44. Which series contains only basic α -amino acids?

Variants of answer:

- a) ala, gly, phe;
- b) ile, leu, val;
- c) arg, lys;
- d) ser, thr;
- e) gly, ala, val.

45. Which series contains only acidic α -amino acids?

Variants of answer:

- a) tyr, asp, glu;
- b) thr, ser, his;
- c) gln, phe, arg;
- d) glu, met, val;
- e) gly, lys, arg.

46. Which series contains only non-polar (hydrophobic) α -amino acids?

Variants of answer:

- a) gly, cys, ile;
- b) phe, val, arg;
- c) phe, leu, met;
- d) tyr, his, ala;
- e) thr, tyr, gly.

47. Which series contains only non-polar (hydrophobic) α -amino acids?

Variants of answer:

- a) val, ser, trp;
- b) asn, gly, leu;

- c) glu, tyr, ile;
- d) val, ala, met;
- e) thr, tyr, gly.

48. Which series contains only polar α -amino acids with acidic ionizable groups?

Variants of answer:

- a) tyr, met, thr;
- b) phe, ser, glu;
- c) lys, gly, ile;
- d) cys, tyr, asp;
- e) thr, gly, tyr.

49. What reagents are used to perform qualitative tests for all α -amino acids?

Variants of answer:

- a) ethyl alcohol in a sulfuric acid medium; acetic anhydride;
- b) nitrous acid ($\text{NaNO}_2 + \text{CH}_3\text{COOH}$); methyl iodide;
- c) ninhydrin; copper (II) carbonate under heating;
- d) formaldehyde; concentrated solution of sodium hydroxide;
- e) sulfuric acid; lactic acid.

50. Xanthoprotein qualitative test (reaction with concentrated nitric acid) is used to determine all α -amino acids from the following series:

Variants of answer:

- a) cysteine, serine;
- b) leucine, isoleucine;
- c) tyrosine, phenylalanine;
- d) cysteine, glycine;
- e) alanine, threonine.

51. The qualitative test reaction with a solution of lead (II) acetate is used for the detection of...

Variants of answer:

- a) cysteine;
- b) serine;
- c) tyrosine;
- d) proline;
- e) glycine.

52. Decarboxylation of histidine leads to the formation of...

Variants of answer:

- a) histamine;
- b) valine;
- c) colamine;

- d) choline;
- e) serotonin.

53. Which compounds are precursors for the biosynthesis of non-essential α -amino acids as a result of reductive amination and transamination in vivo?

Variants of answer:

- a) α -keto acids;
- b) alcohols;
- c) nucleosides;
- d) unsaturated fatty acids;
- e) monosaccharides.

54. Macromolecules of peptides and proteins are constructed from residues of...

Variants of answer:

- a) α -hydroxy carboxylic acids;
- b) α -amino carboxylic acids;
- c) β -oxo carboxylic acids;
- d) polyhydroxy alcohols;
- e) β -amino carboxylic acids.

55. Hydroxylation of phenylalanine in vivo leads to the formation of...

Variants of answer:

- a) threonine;
- b) serine;
- c) tyrosine;
- d) serotonin;
- e) colamine.

56. The Van Slake method uses the reaction of amino acids with...

Variants of answer:

- a) formaldehyde;
- b) ethanol;
- c) nitrous acid;
- d) nitric acid;
- e) ninhydrin.

57. What is the chemical nature of the peptide bond?

Variants of answer:

- a) ester;
- b) hydrogen;
- c) glycosidic;
- d) amide;
- e) anhydride.

58. The primary structure of peptides and proteins...

Variants of answer:

- a) represents the arrangement of atoms in macromolecules;
- b) has a α -helix or β -sheet arrangement;
- c) is not subjected to acid and base catalyzed hydrolysis;
- d) is the sequence of amino acids residues in macromolecules;
- e) is a local conformation of a polypeptide chain resulting from the rotation of its individual sections.

59. Peptides and proteins are...

Variants of answer:

- a) polyesters;
- b) polynucleosides;
- c) polyamides;
- d) polynucleotides;
- e) polysaccharides.

60. Lipids are...

Variants of answer:

- a) organic compounds that are highly soluble in water;
- b) organic compounds insoluble in water, but soluble in nonpolar organic solvents (ethers, chloroform, acetone, benzene);
- c) high molecular weight water-soluble substances;
- d) biopolymers, poorly soluble in water;
- e) organic compounds that are highly soluble in both water and nonpolar organic solvents (toluene, hexane, petroleum ether, cyclohexane).

61. What groups can lipids be classified into depending on their ability to hydrolyze?

Variants of answer:

- a) mono-, oligo- and polysaccharides;
- b) nucleosides and nucleotides;
- c) saponifiable (hydrolyzable) and non-saponifiable (non-hydrolyzable);
- d) ribo- and deoxyribonucleic acids;
- e) simple and complex.

62. Chemically saponifiable lipids are...

Variants of answer:

- a) polyamides;
- b) derivatives of sterane (gonane);
- c) esters;
- d) polyhydroxy alcohols;
- e) hemiacetals.

63. What groups can non-saponifiable lipids be divided into?

Variants of answer:

- a) simple and complex;
- b) peptides and proteins;
- c) fats and phospholipids;
- d) terpenes and steroids;
- e) glycolipids and sphingolipids.

64. Which series contains only saponifiable lipids?

Variants of answer:

- a) steroids, sphingolipids;
- b) phospholipids, waxes;
- c) terpenoids, oils;
- d) fats, terpenes;
- e) glycolipids, steroids.

65. Which series contains only non-saponifiable lipids?

Variants of answer:

- a) fats, oils;
- b) fats, waxes;
- c) terpenoids, steroids;
- d) phospholipids, glycolipids;
- e) lecithins, waxes.

66. What groups can saponifiable lipids be divided into?

Variants of answer:

- a) saturated and unsaturated fatty acids;
- b) long-chain alcohols and fatty acids;
- c) esters and isoprenoids;
- d) simple and complex;
- e) cephalins and lecithins.

67. Steroids are the derivatives of...

Variants of answer:

- a) menthol;
- b) 1-methyl-4-isopropylcyclohexane;
- c) isoprene;
- d) cyclopentanepiperhydrophenanthrene;
- e) perhydronaphthalene.

68. Which series includes only simple saponifiable lipids?

Variants of answer:

- a) terpenes, glycolipids;
- b) triacylglycerols, waxes;

- c) steroids, terpenes;
- d) phospholipids, terpenoids;
- e) cephalins, waxes.

69. Complex saponifiable lipids include...

Variants of answer:

- a) steroids;
- b) phospholipids;
- c) waxes;
- d) triglycerides;
- e) terpenoids.

70. Fats and oils consist of residues of...

Variants of answer:

- a) starch and sphingosine;
- b) glycerol and fatty acids;
- c) myricyl alcohol and palmitic acid;
- d) colamine and fatty acids;
- e) long-chain monohydroxy alcohols and highly branched carboxylic acids.

71. The composition of solid fat molecules is dominated by the residues of...

Variants of answer:

- a) linoleic acid, arachidonic acid;
- b) linoleic acid, stearic acid;
- c) palmitic and stearic acids;
- d) oleic acid, palmitic acid;
- e) linolenic and palmitic acids.

72. The composition of liquid oil molecules is dominated by the residues of...

Variants of answer:

- a) stearic acid, butyric acid;
- b) palmitic acid, oleic acid;
- c) linoleic acid, linolenic acid;
- d) caproic acid, arachidonic acid;
- e) margaric and acetic acids.

73. Which series includes only saturated fatty acids?

Variants of answer:

- a) arachidonic acid, oleic acid;
- b) stearic acid, palmitic acid;
- c) caproic acid, butyric acid;
- d) linoleic acid, linolenic acid;
- e) oleic and palmitic acids.

74. Which series contains only unsaturated fatty acids?

Variants of answer:

- a) linolenic acid, arachidonic acid;
- b) palmitic acid, oleic acid;
- c) stearic acid, caproic acid;
- d) butyric acid, linoleic acid;
- e) arachidonic and acetic acids.

75. Triacylglycerols in terms of composition and chemical structure of the molecule include:

Variants of answer:

- a) 1-palmitoyl-2-oleoyl phosphatidylcholine;
- b) 1-linoleoyl-2-oleoyl-3-stearoyl glycerol;
- c) ethyl acetate;
- d) cetyl palmitate;
- e) mericyl palmitate.

76. Which series includes only complex saponifiable lipids?

Variants of answer:

- a) fats, oils;
- b) waxes, polyhydroxy alcohols;
- c) glycerophospholipids, sphingolipids;
- d) steroids, terpenes;
- e) waxes, oils, fats.

77. Chemically, glycerophospholipids are...

Variants of answer:

- a) fatty acids;
- b) esters of L-phosphatidic acid;
- c) ethers of glycerol and long-chain monohydroxy alcohols;
- d) esters of long-chain monohydroxy alcohols and fatty acids;
- e) long chain polyhydroxy alcohols.

78. The main components of the cell membrane bilayer are...

Variants of answer:

- a) solid fats;
- b) oils;
- c) phospholipids;
- d) terpenoids;
- e) waxes.

79. Saponifiable lipids, as esters, can undergo hydrolysis when heated...

Variants of answer:

- a) only in an acidic medium;
- b) only in a basic medium;

- c) hydrolysis is not possible under any conditions;
- d) in both acidic and alkaline medium;
- e) only in a neutral medium.

80. The products of the saponification reaction of 1-stearoyl-2-linoleoyl-3-oleoyl glycerol with NaOH are glycerol and...

Variants of answer:

- a) $C_{17}H_{33}COONa$, $C_{17}H_{35}COONa$, $C_{15}H_{31}COONa$;
- b) $C_{17}H_{31}COONa$, $C_{17}H_{33}COONa$, $C_{17}H_{35}COONa$;
- c) $C_{17}H_{33}COOH$, $C_{17}H_{33}COOH$, $C_{15}H_{31}COOH$;
- d) $C_{19}H_{31}COONa$, $C_{17}H_{33}COONa$, $C_{17}H_{35}COOH$;
- e) H_2O , $C_{17}H_{29}COOH$, $C_{15}H_{31}COONa$.

81. The product of complete hydrogenation of 1-stearoyl-2-palmitoyl-3-linoleoyl glycerol on a metal catalyst is...

Variants of answer:

- a) 1-stearoyl-2-palmitoyl-3-(10,13-dihydroxystearoyl) glycerol;
- b) 1,2,3-tristearoyl glycerol;
- c) 1,3-distearoyl-2-palmitoyl glycerol;
- d) 1-oleoyl-2-palmitoyl-3-linoleoyl glycerol;
- e) 1,2-palmitoyl-3-stearoyl glycerol.

82. Bromine water turns colorless when mixed with...

Variants of answer:

- a) myricyl palmitate;
- b) 1,2-distearoyl-3-palmitoyl glycerol;
- c) hexane;
- d) 1-stearoyl-2-oleoyl-3-linolenoyl glycerol;
- e) benzene.

83. Saponifiable lipids are oxidized under mild conditions ($KMnO_4$, H_2O) if there are residues in their molecules of...

Variants of answer:

- a) both saturated and unsaturated carboxylic acids;
- b) saturated carboxylic acids only;
- c) palmitic and stearic acids only;
- d) all saponifiable lipids are not oxidized under these conditions;
- e) only oleic and margaric acids.

84. Products of base catalyzed hydrolysis of some lipid are: salt of stearic acid, salt of linolenic acid, salt of phosphoric acid, 2-aminoethan-1-ol. To what type of saponifiable lipids belongs this lipid?

Variants of answer:

- a) triacylglycerols;

- b) phospholipids;
- c) sphingolipids;
- d) waxes;
- e) glycolipids.

85. Products of acid catalyzed hydrolysis of some lipid are: palmitic acid, linoleic acid, phosphoric acid, choline. To what type of saponifiable lipids belongs this lipid?

Variants of answer:

- a) waxes;
- b) phospholipids;
- c) fats;
- d) oils;
- e) sphingolipids.

86. Which of the following information about β -carotene is correct?

Variants of answer:

- a) it is a vitamin of group A;
- b) it is considered a precursor of vitamin B;
- c) it is characterized by reactions of unsaturated compounds and primary alcohols;
- d) it is a natural polyene compound; it undergoes oxidative decomposition in the body to form retinol;
- e) it is an aromatic compound, therefore it has extremely high stability.

87. How many double bonds are contained in the arachidonic acid molecule?

Variants of answer:

- a) two;
- b) five;
- c) it is a saturated fatty acid that does not have double bonds in the molecule;
- d) four;
- e) three.

88. Which of the following information about the structure of steroid molecules is correct?

Variants of answer:

- a) steroids are p,π -conjugated systems with an open chain of conjugation;
- b) stereoisomerism is impossible for them;
- c) steroids are alicyclic compounds, the molecules of which contain a framework of four connected rings with several chiral centers;
- d) all carbon atoms in their structure are sp^2 -hybridized and are arranged in the same plane;
- e) the skeleton of steroid molecules includes three five-membered cycles and one six-membered cycle.

89. The female sex hormones are derivatives of...

Variants of answer:

- a) cholestane;
- b) terpenes;
- c) androstane;
- d) estrane;
- e) glycerol.

90. What hydrocarbon is the parent hydrocarbon for steroids from the group of bile acids?

Variants of answer:

- a) cholane;
- b) estrane;
- c) cholestane;
- d) pregnane;
- e) androstane.

91. What hydrocarbon is the parent hydrocarbon for steroids from the group of corticosteroids?

Variants of answer:

- a) estrane;
- b) cholestane;
- c) pregnane;
- d) cholane;
- e) androstane.

92. The male sex hormones are the derivatives of...

Variants of answer:

- a) estrane;
- b) cholestane;
- c) pregnane;
- d) androstane;
- e) β -carotene.

ANSWERS

1. Fundamentals of the structure and reactivity of organic compounds

№ question	Correct answers	№ question	Correct answers	№ question	Correct answers	№ question	Correct answers	№ question	Correct answers
1	C	17	B	33	C	49	A	65	C
2	B	18	C	34	A	50	C	66	B
3	D	19	D	35	D	51	D	67	D
4	C	20	A	36	D	52	C	68	A
5	D	21	A	37	C	53	B	69	D
6	A	22	C	38	A	54	B	70	B
7	B	23	A	39	D	55	B	71	C
8	C	24	D	40	A	56	C	72	C
9	C	25	B	41	B	57	C	73	C
10	A	26	A	42	C	58	A	74	B
11	A	27	C	43	B	59	A	75	A
12	D	28	B	44	B	60	A	76	C
13	C	29	B	45	A	61	D	77	A
14	C	30	B	46	C	62	B	78	D
15	A	31	C	47	C	63	C		
16	B	32	A	48	A	64	D		

2. Biologically important heterofunctional compounds

№ question	Correct answers	№ question	Correct answers	№ question	Correct answers	№ question	Correct answers	№ question	Correct answers
1	C	11	C	21	C	31	B	41	D
2	B	12	C	22	B	32	A	42	C
3	C	13	B	23	B	33	B	43	B
4	C	14	C	24	B	34	B	44	A
5	C	15	D	25	B	35	B	45	B
6	A	16	D	26	A	36	C	46	B
7	A	17	B	27	C	37	A	47	A
8	C	18	B	28	B	38	D	48	E
9	D	19	D	29	A	39	C	49	A
10	D	20	A	30	D	40	B	50	B

3. Biopolymers and their structural components. Bioregulators

№ question	Correct answers	№ question	Correct answers	№ question	Correct answers	№ question	Correct answers	№ question	Correct answers
1	B	20	D	39	C	58	D	77	B
2	B	21	A	40	D	59	C	78	C
3	B	22	C	41	B	60	B	79	D
4	C	23	C	42	C	61	C	80	B
5	A	24	C	43	B	62	C	81	C
6	D	25	A	44	C	63	D	82	D
7	C	26	D	45	A	64	B	83	A
8	B	27	D	46	C	65	C	84	B
9	A	28	B	47	D	66	D	85	B
10	C	29	A	48	D	67	D	86	D
11	C	30	B	49	C	68	B	87	D
12	B	31	B	50	C	69	B	88	C
13	A	32	B	51	A	70	B	89	D
14	D	33	B	52	A	71	C	90	A
15	A	34	D	53	A	72	C	91	C
16	C	35	B	54	B	73	B	92	D
17	C	36	B	55	C	74	A		
18	C	37	C	56	C	75	B		
19	C	38	B	57	D	76	C		

REFERENCES

1. Биоорганическая химия : учеб. пособие / Е. Г. Тюлькова [и др.]. – Минск : Адукацыя і выхаванне, 2024. – 319 с.
2. Биоорганическая химия : учеб. пособие / О. Н. Ринейская [и др.]. – Минск : Новое знание, 2022. – 280 с.
3. Тюкавкина, Н. А. Биоорганическая химия : учебник / Н. А. Тюкавкина, Ю. И. Бауков, С. Э. Зурабян. – М. : ГЭОТАР-Медиа, 2020. – 416 с.
4. Биоорганическая химия : практикум / М-во здравоохранения Респ. Беларусь, БГМУ ; О. Н. Ринейская [и др.]. – 2-е изд. – Минск : БГМУ, 2020. – 135 с.
5. Биоорганическая химия : рук. к практ. занятиям : учеб. пособие / под ред. Н. А. Тюкавкиной. – М. : ГЭОТАР-Медиа, 2020. – 176 с.
6. Биоорганическая химия : учебник / И. В. Романовский [Задачи с алгоритмами решений по биоорганической химии : учеб.-метод. пособие / М-во здравоохранения Респ. Беларусь, БГМУ ; О. Н. Ринейская [и др.]. – 2-е изд. – Минск : БГМУ, 2021. – 112, [2] с.
7. Павловский, Н. Д. Биоорганическая химия : курс лекций / Н. Д. Павловский, В. К. Гуца. – Гродно : ГрГМУ, 2018. – 174 с.

Учебное издание

Тюлькова Елена Григорьевна
Довнар Анна Константиновна

**БИООРГАНИЧЕСКАЯ ХИМИЯ.
СБОРНИК ТЕСТОВ
(на английском языке)**

Пособие

Редактор *О. М. Пузан*
Компьютерная верстка *О. Н. Сакунова*

Дата подписания к использованию 10.02.2026.
Гарнитура Times New Roman. Объем издания 592 КБ.
Уч.-изд. л. 2,74. Заказ № 51.

Издатель и полиграфическое исполнение:
учреждение образования «Гомельский государственный медицинский университет».
Свидетельство о государственной регистрации издателя,
изготовителя, распространителя печатных изданий № 1/46 от 03.10.2013.
ул. Ланге, 5, 246000, Гомель.