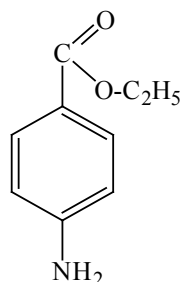


**TREINING MULTIPLE CHOICE QUESTIONS  
FOR THE 1-st CONTROL TESTS.**

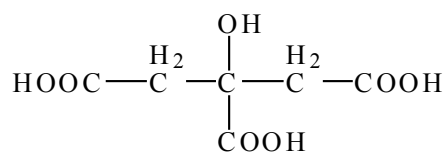
**1. CLASSIFICATION AND NOMENCLATURE OF  
ORGANIC COMPOUNDS.**

1. The IUPAC substitutive name of compound is:



- 1. 4-aminobenzoic acid
- 2. ethyl benzoate
- 3. 4-aminobenzyl ethyl ether
- + 4. ethyl 4-aminobenzoate
- 5. anesthesine

2. The IUPAC substitutive name of compound is:



- + 1. 3-carboxy-3-hydroxy-1,5-pentanedioic acid;
- 2. 2-carboxy-2-hydroxy-1,3-propenedioic acid;
- 3. 3-hydroxy-1,3,5-pentanetricoic acid;
- 4. citric acid;
- 5. 3-hydroxy-1,5-pentanedioic acid.

3. The IUPAC substitutive name of threonine is:

- + 1. 2-amino-3-hydroxybutanoic acid;
- 2. 2-amino-4-methylpentanoic acid;
- 3. 2,6-diaminohexanoic acid.
- 4. 2-aminopropanoic acid;
- 5. 2-amino-3-methylbutanoic acid;

4. According to the classification for functional groups 4-hydroxy-3-ethoxybenzaldehyde is:

- 1. ester;
- 2. carboxylic acid;
- 3. alcohol.
- 4. only phenol;
- + 5. aldehyde, phenol and ether;

5. According to the classification for the main chain structure 2-isopropyl-5-methylcyclohexanol is:

- + 1. carbocyclic compound;

- 2. heterocyclic compound;
- 3. unsaturated compound;
- 4. aromatic compound;
- 5. acyclic compound.

6. Pyrimidine is classified as:

- 1. carbocyclic aromatic compound;
- + 2. heterocyclic compound;
- 3. saturated compound;
- 4. aliphatic compound;
- 5. acyclic compound.

7. Glycerol (1,2,3-propanetriol) is:

- 1. monofunctional compound;
- + 2. polyfunctional compound;
- 3. heterofunctional compound;
- 4. cyclic compound;
- 5. aromatic compound.

8. According to the classification for functional groups epinephrine (2-methylamino-1-(3,4-dihydroxyphenyl)ethanol) is:

- 1. thiol;
- 2. ether and primary alcohol;
- + 3. phenol, secondary alcohol and secondary amine;
- 4. carboxylic acid and primary amine;
- 5. only phenol.

9. One of functional group in the structure of procaine (2-(diethylamino)ethyl 4-aminobenzoate) is:

- 1. an alkoxy group;
- + 2. an ester group;
- 3. a secondary amino group;
- 4. a hydroxyl group;
- 5. a carbonyl group.

10. The substitutive IUPAC name of malic acid is:

- 1. 2,3-dihydroxy-1,2-butanedioic acid;
- 2. 2-hydroxypropanoic acid;
- 3. 2-aminopropanoic acid;
- + 4. 2-hydroxy-1,4-butanedioic acid ;
- 5. 1,4-butanedioic acid.

11. The IUPAC substitutive name of glutamine is:

- + 1. 2-amino-4-carbamoylbutanoic acid;
- 2. 2-amino-3-carbamoylpropanoic acid;
- 3. 2-amino-1,5-pentanedioic acid;
- 4. 4-aminopentanoic acid;
- 5. 2-aminoethanoic acid.

### 3. ELECTRONIC STRUCTURE OF ORGANIC COMPOUNDS.

12. There are only pyridinic heteroatoms in the following compounds:

- 1. 4-ethoxyaniline;
- + 2. ethanal;
- 3. benzoic acid;
- 4. 4-nitrophenol;
- 5. 3-aminopropanoic acid.

13. There are pyrrolic heteroatoms in functional groups of the following families of organic compounds:

- + 1. arylamines;
- 2. saturated aliphatic amines;
- 3. ketones;
- 4. alcohols;
- 5. ethers.

14. There are pyrrolic heteroatoms in functional groups of the following families of organic compounds:

- 1. aldehydes;
- 2. saturated aliphatic amines;
- 3. nitriles;
- 4. alcohols;
- + 5. carboxylic acids.

15. There is  $\pi - \pi$  conjugation in the structure of the following compounds:

- 1. propanol;
- + 2. pentadiene-1,3;
- 3. pentadiene-1,4;
- 4. propanal;
- 5. propanoic acid.

16. There is  $\pi - \pi$  conjugation in the structure of the following compounds:

- + 1. benzene;
- 2. cyclohexene;
- 3. pentadiene-1,4;
- 4. propanal;
- 5. propanoic acid.

17. There is p- $\pi$  conjugation in the structure of the following compounds:

- 1. propanol;
- + 2. 2-hydroxypropanoic acid;
- 3. glycerol;
- 4. pyridine;
- 5. propene-2-al.

18. Covalent sigma bond:

- 1. is formed by side-by-side overlap of p-orbitals;
- 2. has less energy;
- + 3. is formed by end-on overlap of two  $sp^3$  hybrid orbitals;
- 4. is destroyed in the result of the rotation of the molecule part around the bond axis;

- 5. can be easily polarized.

19. Covalent  $\pi$ -bond:

+ 1. is formed by side-by-side overlap of p-orbitals and can be easily polarized;

- 2. has high energy;

- 3. is formed by end-on overlap of two  $sp^3$  hybrid orbitals;

- 4. is not destroyed in the result of the rotation of the molecule part around the bond axis;

- 5. is not polarised.

20. There are only  $sp^3$  hybrid oxygen atoms in the following compounds:

+ 1. ethoxyethane;

- 2. methoxybenzene;

- 3. phenol;

- 4. 4-hydroxybenzyl alcohol;

- 5. oxaloacetic acid.

21. There are no  $sp^2$  hybrid atoms in the following compounds:

+ 1. glycerol;

- 2. propanoic acid;

- 3. Thymine (2,4-dihydroxy-5-methylpyrimidine);

- 4. phenol;

- 5. aniline.

22. Aromatic compounds:

- 1. cyclohexane;

- 2. cyclooctatetraene;

- 3. 1,3-cyclopentadiene;

- 4. ethylene;

+ 5. benzene.

23. Aromatic compounds:

- 1. cyclohexane;

- 2. cyclooctatetraene;

- 3. acetylene;

+ 4. pyrrole;

- 5. 1,3-cyclopentadiene.

24. The functional group has only negative inductive effect in the following compounds:

- 1. phenol;

+ 2. ethylene glycol;

- 3. aniline;

- 4. ethandioic acid;

- 5. methyl phenyl ketone.

25. The functional group has negative inductive and negative mesomeric (resonance) effects simultaneously in the following compounds:

- 1. phenol;

- 2. ethylene glycol;

- 3. propanamine-2;

- 4. 1,4-butandioic acid;
- + 5. methyl phenyl ketone.

26. The functional group has negative resonance (mesomeric) effect in the following compound:

- 1. ethanol;
- 2. glycerol;
- 3. acetone;
- + 4. butene-2-al-1;
- 5. 4-methylaniline.

27. The following compound has only electron attracting functional groups:

- + 1. 2-aminoethanol-1;
- 2. 2-hydroxybenzoic acid;
- 3. 4-aminobenzenesulfonic acid;
- 4. 4-hydroxy-3-methylbenzaldehyde;
- 5. cytosine (4-amino-2-hydroxypyrimidine).

28. Which of the following compound has all functional groups as electron donating:

- 1. 2-isopropyl-5-methylcyclohexanol;
- + 2. 2-isopropyl-5-methylphenol;
- 3. n-aminobenzaldehyde;
- 4. succinic acid (1,4-butanedioic acid);
- 5. 2,3-dihydroxypropanal.

### 3. STEREOCHEMISTRY OF ORGANIC COMPOUNDS.

29. The Newman projection formulas are used to show the peculiarity of:

- 1. chemical structure of the compound;
- + 2. the conformation of the molecule;
- 3. the constitutional isomers;
- 4. the configuration;
- 5. the structure of E and Z pi-diastereomers.

30. The molecule of 1,2-dimethylcyclohexane has the maximum energy in chair conformation when:

- 1. both methyl groups are placed on the equatorial bonds;
- + 2. both methyl groups are placed on the axial bonds;
- 3. one of the methyl groups is placed on the axial bond;
- 4. one of the methyl groups is placed on the equatorial bond;
- 5. one of the methyl groups is placed on the axial bond and other on the equatorial bond.

31. The potential energy of propanamine-1 *anti*-conformation is less than its *gauche*-conformation because the molecule in *anti*-conformation has:

- 1. less angle strain;
- 2. another configuration;
- 3. less torsional strain;
- + 4. less Van-der-Vaals strain;
- 5. another chemical structure.

32. The potential energy of butanol-2 eclipsed conformation is more than its staggered conformation because the molecule in eclipsed conformation has:

- 1. another configuration;
- + 2. more torsional strain and higher Van-der-Vaals repulsion;
- 3. more angle strain;
- 4. less torsional strain;
- 5. another electronic structure;

33. The conformations of 1-chloropropane with torsional angle  $60^\circ$  and  $300^\circ$  are degenerated because the molecule in these conformations has:

- + 1. the same torsional and Van-der-Vaals strains;
- 2. the same configurations;
- 3. the same chemical structure;
- 4. the different configurations;
- 5. the same electronic structure.

34. The chiral molecule is:

- 1. glycine (2-aminoethanoic acid);
- + 2. proline;
- 3. xylitol;
- 4. butanol-1;
- 5. pentanol-3.

35. The chiral molecules are:

- + 1. D-glucose and alanine;
- 2. citric acid and acetoacetic acid;
- 3. 2-aminoethanol-1;
- 4. adenine;
- 5. furfural (2-furancarbaldehyde).

36. 2-aminopropanoic acid has the following number of stereoisomers:

- 1. 1;
- + 2. 2;
- 3. 3;
- 4. 4;
- 5. 5.

37. 2,3,4-trihydroxybutanal has the following number of stereoisomers:

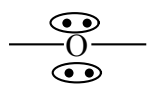
- 1. 1;
- 2. 2;
- 3. 3;
- + 4. 4;
- 5. 5.

38. 2,3-dihydroxy-1,4-butanedioic acid has the following number of stereoisomers:

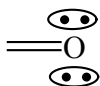
- 1. 1;
- 2. 2;
- + 3. 3;
- 4. 4;
- 5. 5.

#### **4. ACID-BASE PROPERTIES OF ORGANIC COMPOUNDS.**

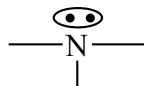
39. The acidic reaction centre is:



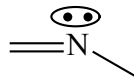
1.



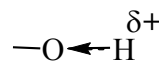
2.



3.



4.



5.

- 1.
- 2.
- 3.
- 4.
- + 5.

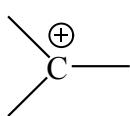
40. The functional group of the following family of organic compounds has the OH-acidic reaction centre:

- 1. esters;
- 2. ketones;
- + 3. sulfonic acids;
- 4. acyl chlorides;
- 5. ethers.

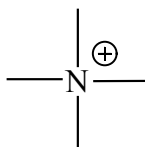
41. The functional group of the following family of organic compounds has the NH-acidic reaction centre:

- 1. esters;
- 2. ketones;
- 3. acid anhydride;
- + 4. amides;
- 5. ethers.

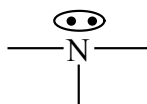
42. The basic reaction centre is :



1.



2.



3.



4.



5.

- 1.
- 2.
- + 3.
- 4.
- 5.

43. The functional group of the following family of organic compounds has the basic reaction centre on the nitrogen atom:

- 1. esters;
- 2. ketones;
- + 3. amines;
- 4. amides;
- 5. ethers.

44. The strongest acidic reaction centre of 3,4-dihydroxyphenylalanine (DOPA) (2-amino-3-(3,4-dihydroxyphenyl)propanoic acid) molecule is:

- 1. CH-acidic centre;
- 2. NH-acidic centre;
- 3. phenol OH group;
- + 4. carboxylic acid OH group;
- 5. amino group.

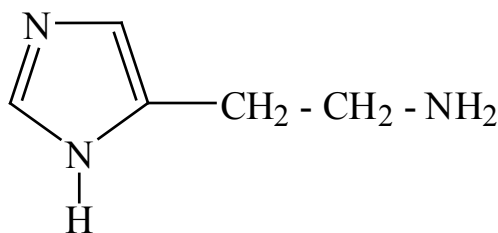
45. The organic compound with the strongest OH-acidic reaction centre is:

- 1. ethanoic acid;
- 2. propanoic acid;
- 3. 2-methylpropanoic acid;
- + 4. 2,2,2-trichloroethanoic acid;
- 5. 2-aminopropanoic acid.

46. The weakest acid is:

- + 1. ethanamine;
- 2. ethanol;
- 3. phenol;
- 4. ethanoic acid;
- 5. ethanethiol.

47. The strongest basic reaction centre of histamine molecule is:



- + 1.  $sp^3$  hybridized nitrogen atom;
- 2.  $sp^2$  hybridized pyrrole nitrogen atom;
- 3.  $sp^2$  hybridized pyridine nitrogen atom;
- 4. conjugated system with closed chain;
- 5. reactivity of all basic centres are equal.

48. The strongest base is:

- 1. 2-aminoethanol;
- 2. ethanamine;
- 3. methylamine;
- + 4. dimethylamine;
- 5. pyridine.

49. Which of the following compounds have acidic properties and form salts in reaction with strong base:

- 1. pyridine;
- 2. thiophene;
- 3. pyridine;
- + 4. barbituric acid (2,4,6-trihydroxypyrimidine);
- 5. oxazole (1-aza-3-oxocyclopenta-2,4-diene);

## 5. CLASSIFICATION AND THE MECHANISMS OF THE REACTIONS



**IN ORGANIC CHEMISTRY.**  
**HYDROCARBONS. S<sub>R</sub>, S<sub>E</sub>, A<sub>E</sub> REACTIONS.**

50. According to the product the organic reactions types are:

- 1. bimolecular;
- + 2. addition, substitution and elimination;
- 3. unimolecular;
- 4. nucleophilic;
- 5. synchronic.

51. According to the type of the reagent organic reactions types are:

- 1. bimolecular;
- 2. substitution and elimination;
- 3. unimolecular;
- + 4. nucleophilic and electrophilic;
- 5. synchronic.

52. The bonds are broken by homolysis in the molecules of the following compound:

- 1. HCl;
- 2. CH<sub>3</sub>Cl;
- + 3. CH<sub>3</sub> – CH<sub>3</sub>;
- 4. HCN;
- 5. H<sub>2</sub>SO<sub>4</sub>.

53. The bonds are broken by heterolysis in the molecules of the following compound:

- 1. Br<sub>2</sub>;
- 2. CH<sub>3</sub> – CH<sub>3</sub>;
- 3. Cl<sub>2</sub>;
- + 4. CH<sub>3</sub> – CH<sub>2</sub> – Cl;
- 5. CH<sub>3</sub> – CH<sub>2</sub> – CH<sub>3</sub>.

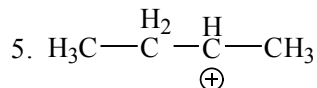
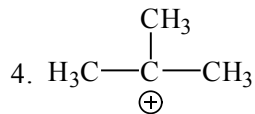
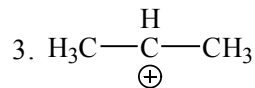
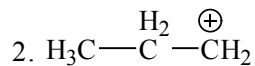
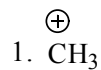
54. The electrophilic reagent is the next of the following:

- 1. ·OH;
- + 2. Br<sup>+</sup>;
- 3. Br<sup>-</sup>;
- 4. CH<sub>3</sub>-NH<sub>2</sub>;
- 5. CH<sub>3</sub>-O<sup>-</sup>.

55. The nucleophilic reagent is the next of the following:

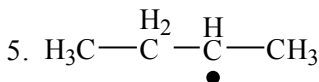
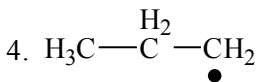
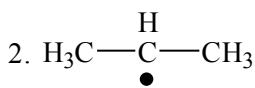
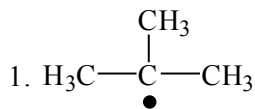
- + 1. C<sub>2</sub>H<sub>5</sub>-NH<sub>2</sub>;
- 2. Br<sup>+</sup>;
- 3. NO<sub>2</sub><sup>+</sup>;
- 4. H<sup>+</sup>;
- 5. CH<sub>4</sub>.

56. The most stable is the following carbocation:



- 1;
- 2;
- 3;
- +4;
- 5.

57. The most stable is the following carbon radical:



- +1;
- 2;
- 3;
- 4;
- 5.

58. The alkanes react according to the following mechanisms:

- 1. An-E;
- 2. A<sub>R</sub>;
- 3. S<sub>E</sub>;
- + 4. S<sub>R</sub>;
- 5. A<sub>E</sub>.

59. The product of the reaction of 2-methylpentane and bromine is:

- 1. 1-bromo-4-methylpentane;
- 2. 2-bromo-4-methylpentane;
- 3. 3-bromo-4-methylpentane;
- + 4. 2-bromo-2-methylpentane;
- 5. 1-bromo-2-methylpentane.

60. The reaction of butane bromination occurs in the following conditions:

- 1. the room temperature;
- + 2. ultraviolet irradiation;
- 3. cooling;
- 4.  $\text{AlCl}_3$  as catalyst;
- 5. the acidic solution.

61. The chlorination reaction occurs as the radical substitution reaction for the following compound:

- 1. cyclohexene;
- 2. benzene;
- + 3. 2-methylbutane;
- 4. acetylene;
- 5. 2-methyl-1,3-butadiene.

62. Alkenes and alkadienes participate in the following reactions:

- + 1.  $\text{A}_\text{E}$ ;
- 2.  $\text{A}_\text{N}$ ;
- 3.  $\text{S}_\text{E}$ ;
- 4.  $\text{S}_\text{R}$ ;
- 5.  $\text{S}_\text{N}$ .

63. The reaction of cyclohexene bromination occurs in the following conditions:

- + 1. the room temperature and neutral solution;
- 2. the high temperature;
- 3. ultraviolet irradiation;
- 4.  $\text{AlCl}_3$  as catalyst;
- 5. the acidic solution.

64. The product of 1-pentene hydrobromation is:

- 1. 1-bromopentane;
- + 2. 2-bromopentane;
- 3. 3-bromopentane;
- 4. 1,2-dibromopentane;
- 5. pentane.

65. The reaction of 2-butene hydration occurs in the following conditions:

- 1. the room temperature and the neutral solution;
- 2. the excess of  $\text{NaOH}$ ;
- 3. ultraviolet irradiation;
- 4.  $\text{FeCl}_3$  as catalyst;
- + 5. the acidic catalyst.

66. The product of the 2-methyl-2-butene hydration reaction is:

- 1. 2-methylbutane;
- 2. 2-methyl-1,2-butanediol;
- 3. 2-methyl-2,3-butanediol;
- + 4. 2-methyl-2-butanol;
- 5. 3-methyl-2-butanol.

67. The product of the 2-methyl-2-butenoic acid hydration reaction is:

- 1. 2-methylbutane;
- 2. 2-methylbutanal;
- 3. 2-methylbutanoic acid;
- 4. 2-methyl-2-hydroxybutanoic acid;
- + 5. 2-methyl-3-hydroxybutanoic acid.

68. The product of the fumaric acid (*trans*-2-butenedioic acid) hydration reaction is:

- 1. 2-hydroxybutanoic acid;
- 2. 2,3-dihydroxybutanoic acid;
- + 3. 2-hydroxybutanedioic acid;
- 4. 2,3-dihydroxybutanedioic acid;
- 5. citric acid.

69. The product of the aconitic acid (3-carboxy-2-pentenedioic acid) hydration reaction according to the Markovnikov's rule is:

- 1. malic acid;
- 2. lactic acid;
- 3. acetoacetic acid;
- 4. isocitric acid;
- + 5. citric acid.

70. Conjugated alkadienes unlike simple alkenes participate in the following reactions:

- 1. only 1,2-electrophilic addition;
- + 2. 1,2- and 1,4-electrophilic addition;
- 3. electrophilic substitution;
- 4. nucleophilic substitution;
- 5. elimination.

71. The reaction of equimolecular 1,3-butadiene bromination results:

- 1. 3-bromo-1-butene;
- 2. 4-bromo-1-butene;
- 3. only 3,4-dibromo-1-butene;
- + 4. 3,4-dibromo-1-butene and 1,4-dibromo-2-butene;
- 5. 1,3-dibromobutane.

72. The product of oxidation of 2-methyl-2-butene with  $\text{KMnO}_4$  solution (without heating) is:

- 1. 2-methyl-2-butanol;
- 2. acetone and ethanoic acid;
- 3. 2-methylbutane;
- 4. 2-methyl-2,3-epoxybutane;
- + 5. 2-methyl-2,3-butanediol.

73. Qualitative test on unsaturated hydrocarbons can be carried out with following compounds:

- 1.  $\text{H}_2\text{SO}_4$ ;
- 2.  $\text{O}_3/\text{H}_2\text{O}$ ;
- + 3.  $\text{Br}_2, \text{H}_2\text{O}$ ;
- 4.  $\text{HBr}$ ;
- 5.  $\text{KCr}_2\text{O}_7, \text{H}_2\text{SO}_4 / t^\circ$ .

74. Using the reaction with bromine water at the room temperature the following compound can be identified:

- 1. pentane;
- + 2. pentene-2;
- 3. cyclopentane;
- 4. benzene;
- 5. toluene.

75. Qualitative test on unsaturated hydrocarbons can be carried out with following compounds:

- 1.  $\text{H}_2\text{SO}_4$ ;
- 2.  $\text{O}_3/\text{H}_2\text{O}$ ;
- 3.  $\text{FeCl}_3$ ;
- 4.  $\text{HBr}$ ;
- + 5.  $\text{KMnO}_4$ ,  $\text{H}_2\text{O}$ .

76. The aromatic ring of toluene is characterized by following:

- 1. the acyclic structure;
- 2.  $\text{sp}^2$  and  $\text{sp}^3$  hybridization types of carbon atoms are present simultaneously;
- 3. absence of the planar structure;
- + 4. cyclic conjugated system with the number of  $\pi$ -electrons according to the Huckel's rule:  $N=4n+2$ ;
- 5. the number of  $\pi$ -electrons corresponds to the equilibrium:  $N=2^n$ .

77. Benzene is characterized by the following reactions:

- 1.  $\text{S}_\text{N}$ ;
- + 2.  $\text{S}_\text{E}$ ;
- 3.  $\text{S}_\text{R}$ ;
- 4. oxidation;
- 5.  $\text{A}_\text{E}$ .

78. The reaction of benzene bromination occurs in the following conditions:

- 1. the room temperature;
- 2. ultraviolet irradiation;
- 3. cooling;
- + 4.  $\text{AlCl}_3$  as catalyst and relatively high temperature;
- 5.  $\text{pH} < 7$ .

79. The product of phenol bromation with bromine water is:

- 1. 2-bromophenol;
- 2. 3-bromophenol;
- 3. 4-bromophenol;
- 4. 3,5-dibromophenol;
- + 5. 2,4,6-tribromophenol.

80. The reaction of methoxybenzene mononitration results:

- + 1. 1-methoxy-2-nitrobenzene and 1-methoxy-4-nitrobenzene;
- 2. 1-methoxy-3-nitrobenzene;
- 3. 1-methoxy-2,3-dinitrobenzene;

- 4. 1-methoxy-3,5-dinitrobenzene;
- 5. 1-methoxy-2,3,5-trinitrobenzene.

81. The reaction of benzoic acid with concentrated sulfuric acid in heating results:

- 1. 2-sulfo benzoic acid;
- +2. 3-sulfo benzoic acid;
- 3. 4-sulfo benzoic acid;
- 4. 3,4-disulfo benzoic acid;
- 5. benzenesulfonic acid.

82. The product of benzaldehyde monomethylation reaction is:

- 1. 2-methylbenzaldehyde;
- +2. 3-methylbenzaldehyde;
- 3. 4-methylbenzaldehyde;
- 4. 2,3-dimethylbenzaldehyde;
- 5. methyl phenyl ketone.

83. The reaction of toluene with acetyl chloride in presence of  $\text{FeCl}_3$  results:

- 1. benzyl methyl ketone;
- +2. 2-acetyltoluene and 4-acetyltoluene;
- 3. 3-acetyltoluene;
- 4. 2,3-diacetyltoluene;
- 5. 3,4-diacetyltoluene.

84. The general practical result of toluene oxidation by  $\text{KMnO}_4/\text{H}_2\text{SO}_4$  in heating is:

- 1. the brown precipitate forming;
- + 2. bleaching of the solution;
- 3. bubbles of the gas;
- 4. no changes;
- 5. change of pH meaning.

## **6. ALCOHOLS, PHENOLS, THIOLS, AMINES. S<sub>N</sub> AND E REACTIONS.**

85. Ethanol is:

- 1. secondary alcohol;
- + 2. monohydric primary alcohol;
- 3. polyhydric alcohol;
- 4. aromatic alcohol;
- 5. unsaturated alcohol.

86. Glycerol is:

- 1. monohydric primary alcohol;
- 2. dihydric phenol;
- + 3. polyhydric vicinal alcohol;
- 4. tertiary alcohol;
- 5. geminal alcohol.

87. *Tert.*-butyl alcohol is:

- 1. monohydric primary;
- 2. monohydric secondary;

- + 3. monohydric tertiary;
- 4. polyhydric vicinal;
- 5. polyhydric geminal.

88. Propargyl alcohol is:

- 1. primary saturated;
- 2. secondary saturated ;
- 3. tertiary saturated;
- + 4. primary unsaturated;
- 5. secondary unsaturated.

89. Primary aromatic alcohol is:

- 1. methanol;
- + 2. benzyl alcohol;
- 3. isobutyl alcohol;
- 4. isopropyl alcohol;
- 5. cyclohexyl alcohol.

90. Primary saturated alcohol is:

- 1. methanol;
- 2. benzyl alcohol;
- + 3. isobutyl alcohol;
- 4. isopropyl alcohol;
- 5. cyclohexyl alcohol.

91. Secondary alcohols are:

- + 1. pentanol-3 and isopropyl alcohol;
- 2. propene-2-ol and propyne-2-ol;
- 3. 2-methylbutanol-2;
- 4. allyl alcohol and benzyl alcohol;
- 5. ethyl alcohol and tert.-butyl alcohol.

92. Tertiary alcohol is:

- 1. 1,2,3-Trihydroxybenzen;
- 2. 2-methylpentanol-3;
- + 3. 2-methylpropanol-2;
- 4. cyclohexanol;
- 5. butanol-2.

93. According to the IUPAC substitutive nomenclature the name of hydroquinone is:

- 1. phenylmethanol;
- 2. cyclohexanol;
- 3. 2-isopropyl-5-methylcyclohexanol-1;
- 4. 1,2-dihydroxybenzene;
- + 5. 1,4-dihydroxybenzene.

94. According to the IUPAC substitutive nomenclature the name of ethyl methyl ether is:

- 1. methylthioethane;
- + 2. methoxyethane;
- 3. methoxybenzene;

- 4. 1,2-dimethoxyethane;
- 5. 2-methoxyethanol.

95. The tertiary amine is:

- 1. *tert.*-butylamine;
- 2. isobutylamine;
- + 3. trimethylamine;
- 4. dimethylamine;
- 5. aniline.

96. There are only  $sp^3$  hybrid oxygen atoms in the following compound:

- + 1. glycerol;
- 2. phenol;
- 3. hydroquinone;
- 4. catechol;
- 5. Anisole (methoxybenzene).

97. There are only  $sp^2$  hybrid oxygen atoms in the following compound:

- 1. glycerol;
- 2. 1-propanol;
- 3. diethyl ether;
- + 4. catechol;
- 5. tetrahydrofuran.

98. There are only pyrrole oxygen atoms in the molecules of the following compound:

- 1. glycerol;
- + 2. resorcinol;
- 3. ethanol;
- 4. picric acid (2,4,6-trinitrophenol);
- 5. ethoxyethane.

99. Propanol-1 has following reaction centres:

- 1. NH-acidic and ammonium basic;
- 2. SH-acidic;
- 3. only electrophilic, but not nucleophilic;
- + 4. OH-acidic, basic, electrophilic and nucleophilic;
- 5. it doesn't have any reaction centres.

100. Phenol has following reaction centers:

- + 1. OH-acidic and nucleophilic;
- 2. SH-acidic;
- 3. electrophilic;
- 4. strong basic;
- 5. CH-acidic.

101. One of reaction center of ethanethiol is:

- 1. OH-acidic;
- 2. CH-acidic;
- + 3. SH-acidic;
- 4. NH-acidic;



- 5. electrophilic.

102. The strength of OH-acidic centers increases from left to right in the following order:

- 1. glycerol → ethanol → phenol;
- 2. glycerol → catechol → methanol;
- + 3. isopropyl alcohol → glycerol → resorcinol;
- 4. hydroquinone → glycerol → propanol;
- 5. *o*-cresol → *sec*-butyl alcohol → 1,2,3-propanetriol.

103. Which of the following compounds will react with sodium hydroxide:

- 1. CH<sub>3</sub>CH<sub>2</sub>OH;
- 2. C<sub>6</sub>H<sub>5</sub>CH<sub>2</sub>OH;
- + 3. C<sub>6</sub>H<sub>5</sub>OH;
- 4. (CH<sub>3</sub>)<sub>2</sub>CHOH;
- 5. CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>OH.

104. Phenol is dissolved in:

- 1. the water;
- + 2. the alkaline solution;
- 3. acids;
- 4. the NaHCO<sub>3</sub> saturated solution;
- 5. the NaCl saturated solution.

105. The chelate complex formation with Cu(OH)<sub>2</sub> is qualitative test for discovery of:

- 1. monohydric alcohols;
- 2. primary and secondary alcohols;
- 3. ethers;
- + 4. polyhydric vicinal alcohols;
- 5. phenols.

106. Using the reaction of chelate formation with Cu(OH)<sub>2</sub> the following compound can be identified:

- 1. phenol;
- + 2. glycerol;
- 3. catechol;
- 4. ethyl alcohol;
- 5. cyclohexene.

107. The general practical result of polyhydric vicinal alcohol complex formation reaction with Cu(OH)<sub>2</sub> is:

- + 1. dissolving of the Cu(OH)<sub>2</sub> light-blue precipitate to give dark-blue solution;
- 2. blue-green solution ;
- 3. bleaching solution;
- 4. violet colour;
- 5. bubbles of gas.

108. The violet coloured complex product is the result of the reaction of FeCl<sub>3</sub> and:

- 1. 2-propanol;
- 2. glycerol;

- + 3. phenol;
- 4. formaldehyde;
- 5. tartaric acid.

109. The strongest base is:

- 1. isobutyl alcohol;
- 2. butanethiol ;
- 3. resorcinol;
- 4. isobutylamine;
- + 5. isobutylmethylamine.

110. The basic reaction centre of ethers on the oxygen atom provides their reactions:

- + 1. with strong acids;
- 2. with strong bases;
- 3. oxidation;
- 4. reduction;
- 5. with electrophiles.

111. Nucleophilic properties of heteroatoms are increasing in range:

- + 1. 2-methylphenol → 2-methylpropanol-1 → 2-methylpropanamine-1;
- 2. 2-ethoxypropane → 2-isopropyl-5 methylphenol → thiophenol;
- 3. methylthiobenzen → methylthioethane → benzenediol-1,4;
- 4. dioxane-1,4 → cyclohexanol → Ethoxybenzen;
- 5. propanthiol → propanol-2 → ethylthioethane.

112. Alcohols as nucleophilic reagents react with the following family of organic compounds:

- 1. thios;
- + 2. carboxylic acids;
- 3. amines;
- 4. phenols;
- 5. alkenes.

113. The tertiary alcohol undergoes the following reactions with the electrophilic centre:

- 1.  $A_N$ ;
- 2.  $A_E$ ;
- 3.  $A_{N-E}$ ;
- + 4.  $S_N1$ ;
- 5.  $S_N2$ .

114. In nucleophilic substitution reactions ( $S_N$ ) alcohol molecule can be:

- 1. a radical reagent;
- + 2. a nucleophilic reagent and a substrate with electrophilic centre;
- 3. an electrophilic reagent and a substrate with nucleophilic centre;
- 4. only a substrate with electrophilic centre;
- 5. only a substrate with nucleophilic centre.

115. Which of the following compound is most reactive in  $S_N1$  reactions as substrate?

- 1. ethanol;
- 2. isobutyl alcohol;

- 3. 2-butanol;
- + 4. 2-methyl-2-propanol;
- 5. cyclohexanol.

116. Which of the following compound is most reactive in  $S_N2$  reactions as substrate?

- + 1. ethanol;
- 2. isobutyl alcohol;
- 3. 2-butanol;
- 4. 2-methyl-2-propanol;
- 5. cyclohexanol.

117. Inversion of configuration takes place at the stereocentre of chiral alcohols molecules in reactions according to the mechanism:

- 1.  $S_N1$ ;
- + 2.  $S_N2$ ;
- 3.  $A_E$ ;
- 4.  $A_N$ ;
- 5.  $E1$ .

118. Which of the following can readily undergo dehydration:

- 1. ethanol;
- + 2. *tert*-butyl alcohol;
- 3. phenol;
- 4. benzyl alcohol;
- 5. acetic acid.

119. Hydroxyl group in phenols is:

- 1. both *o,p*-directing and deactivating;
- + 2. both *o,p*-directing and activating;
- 3. both *m*-directing and activating;
- 4. both *m*-directing and deactivating;
- 5. only *m*-directing.

120. Which of the following compound is most reactive in  $S_E$  reactions?

- + 1. phenol;
- 2. benzoic acid;
- 3. benzene;
- 4. toluene;
- 5. naphthalene.

121. The main products of the phenol C-methylation reaction (in presence  $AlCl_3$ ) are:

- + 1. 2-methylphenol and 4-methylphenol;
- 2. 3-methylphenol;
- 3. methoxybenzene;
- 4. 3,5-dimethylphenol;
- 5. phenyl acetate.

122. The reaction of phenol with methylchloride in alkaline solution mainly results:

- 1. 2-methylphenol and 4-methylphenol;

- 2. 3-methylphenol;
- + 3. methoxybenzene;
- 4. 3,5-dimethylphenol;
- 5. phenyl acetate.

123.  $K_2Cr_2O_7$  in presence the  $H_2SO_4$  solution in heating oxidizes:

- 1. only primary alcohols;
- 2. only secondary alcohols;
- + 3. primary and secondary alcohols;
- 4. tertiary alcohols;
- 5. ethers.

## 7. CARBONYL COMPOUNDS. ALDEHYDES AND KETONES. A<sub>N</sub> REACTIONS.

124. The reaction centres of aldehydes are:

- + 1. electrophilic, basic, alfa-CH-acidic;
- 2. only nucleophilic and basic;
- 3. only nucleophilic, basic and OH-acidic;
- 4. only electrophilic and nucleophilic;
- 5. only basic and alfa-CH-acidic.

125. Aromatic hydrocarbons that have oxo-group, with straight bonding to the aromatic ring have no following reaction centres:

- 1. electrophilic;
- 2. electrophilic and basic;
- 3. basic, electrophilic, alfa-CH-acidic;
- + 4. alfa-CH-acidic;
- 5. basic.

126. Cyclohexanone is classified as:

- 1. aliphatic aldehyde;
- 2. aromatic aldehyde;
- 3. aromatic ketone;
- + 4. carbocyclic ketone;
- 5. heterocyclic ketone.

127. Aldehydes and ketones are characterized by the following reactions:

- 1. S<sub>E</sub>;
- 2. S<sub>N</sub>;
- 3. A<sub>E</sub>;
- + 4. A<sub>N</sub>;
- 5. S<sub>R</sub>.

128. Aldehydes and ketones are not characterized by the following reactions:

- 1. A<sub>N</sub>;
- 2. A<sub>N</sub>-E;
- 3. reduction and oxidation;
- 4. reactions of alfa-CH-acidic centre.

+ 5. S<sub>N</sub>.

129. The most reactive in A<sub>N</sub> reactions is:

- 1. ethanal;
- + 2. chloral (2,2,2-trichloroethanal);
- 3. acetone;
- 4. methyl phenyl ketone;
- 5. 2,2-dimethylpropanal.

130. The role of acid catalyst in A<sub>N</sub> reactions of aldehydes and ketones is:

- 1. increasing of electrophilic carbon opening;
- 2. changing of configuration;
- 3. decreasing of electrophilic centre carbon positivity and reactivity;
- + 4. increasing of electrophilic centre carbon positivity and reactivity;
- 5. leaving group formation.

131. The product of the addition reaction of water to the aldehyde is:

- 1. ketone;
- 2. ester;
- 3. vicinal alcohol;
- + 4. geminal dihydric alcohol;
- 5. hemiacetal.

132. The final product of the reaction between ethanol and propanal in presence of gaseous HCl is:

- 1. ethyl propanoate;
- 2. propyl ethanoate;
- + 3. 1,1-diethoxypropane;
- 4. 1,1-dipropoxyethane;
- 5. 1-ethoxypropane.

133. The 1,1-dimethoxyethane acid catalyzed hydrolysis reaction results:

- 1. methanol and ethanol;
- + 2. methanol and ethanal;
- 3. methanal and ethanol;
- 4. methanol and ethanoic acid;
- 5. methane and ethanoic acid.

134. 1,1-dimethoxybutane can be synthesized by the reaction between following compounds:

- 1. methanol and butanoic acid;
- 2. butanol and formic acid;
- 3. methanal and butanol;
- + 4. methanol and butanal;
- 5. methanol and butanol.

135. The mechanism of reactions of aldehydes and ketones with amines is:

- 1. A<sub>N</sub>;
- 2. S<sub>N</sub>;
- 3. E;

- + 4. A<sub>N</sub>-E;
- 5. A<sub>E</sub>.

136. The reaction of aldehydes and ketones with primary amines gives:

- 1. hemiacetals;
- 2. acetals;
- 3. oximes;
- + 4. imines;
- 5. 2,4-dinitrophenylhydrazones.

137. The qualitative test for discovery of a carbonyl group in the structures of aldehydes and ketones can be realized with following compound:

- 1. Br<sub>2</sub> / H<sub>2</sub>O;
- 2. Tollen's reagent / t<sup>0</sup>;
- 3. FeCl<sub>3</sub>;
- 4. I<sub>2</sub> / NaOH;
- + 5. 2,4-dinitrophenylhydrazine;

138. Reactions of alfa-CH-acidic reaction centre are possible for the following compound:

- 1. benzaldehyde;
- 2. formaldehyde;
- + 3. acetone;
- 4. 2,2-dimethylbutanal;
- 5. 2-ethyl-2-phenylpentanal.

139. Reactions of alfa-CH-acidic reaction centre are possible for the following compound:

- 1. benzaldehyde
- + 2. ethanal;
- 3. formaldehyde;
- 4. 2,2-dimethylbutanal;
- 5. 2-ethyl-2-isopropylpentanal.

140. The haloform reaction is possible for the following compound:

- 1. formaldehyde;
- + 2. ethanal;
- 3. benzaldehyde;
- 4. formic acid;
- 5. diphenyl ketone.

141. The iodoform test is qualitative test for discovery of an alfa-methylcarbonyl group in the following compound:

- + 1. acetone;
- 2. diphenyl ketone;
- 3. benzaldehyde;
- 4. formaldehyde;
- 5. methanal.

142. The following compound forms the primary alcohols as the result of the reduction reaction:

- 1. acetone;
- + 2. propanal;

- 3. 2-pentanone;
- 4. methyl propyl ketone;
- 5. acetophenone.

143. 3-methyl-2-butanol can be product of the reduction reaction of the following compound:

- 1. 3-methylbutanal;
- 2. 3-methylpentanal;
- + 3. 3-methyl-2-butanone;
- 4. 2-methyl-3-butanone;
- 5. 2-pentanone.

144. Cupric hydroxide (II)- $\text{Cu}(\text{OH})_2$  in the basic solution (in heating) doesn't oxidize the following carbonyl compound:

- 1. formaldehyde;
- 2. propanal;
- + 3. acetone;
- 4. 3-methylpentanal;
- 5. 2-methylbutanal.

145. As the result of oxidation of benzaldehyde by Tollen's reagent forms:

- 1. benzyl alcohol and brick-red precipitate;
- + 2. benzoic acid (its salt) and silver mirror;
- 3. benzyl alcohol and silver mirror;
- 4. benzene and brick-red precipitate;
- 5. benzoic acid (its salt) and brick-red precipitate.

146. As the result of disproportionation reaction of formaldehyde the following compounds are formed;

- 1. methanol and water;
- + 2. methanol and methanoic acid;
- 3. formic acid and water;
- 4. methanol and hydrogen;
- 5. methanol, methanoic acid, water and hydrogen.

### **8. CARBOXYLIC ACIDS AND DERIVATIVES. $\text{S}_\text{N}$ REACTIONS.**

147. According to the number of carboxyl groups carboxylic acids can be classified as:

- + 1. Monocarboxylic and dicarboxylic;
- 2. unsaturated;
- 3. saturated;
- 4. aliphatic;
- 5. aromatic.

148. According to the carbon chain structure carboxylic acids can be classified as:

- 1. Monocarboxylic;
- 2. dicarboxylic;
- 3. tricarboxylic;
- + 4. aliphatic and aromatic;
- 5. amino acids.

149. Monocarboxylic aliphatic saturated carboxylic acid is:

- + 1. ethanoic;
- 2. ethanedioic;
- 3. benzoic;
- 4. 2-butenic acid;
- 5. phthalic acid (1,2-benzene dicarboxylic acid).

150. Monocarboxylic aromatic carboxylic acid is:

- 1. ethanoic;
- 2. ethanedioic;
- + 3. benzoic;
- 4. 2-butenic acid;
- 5. phthalic acid (1,2-benzene dicarboxylic acid).

151. Dicarboxylic aliphatic acids are:

- 1. acetic acid and butyric acid;
- + 2. oxalic acid (ethanedioic acid) and succinic acid (butanedioic acid);
- 3. acrylic acid (propenoic acid);
- 4. isophthalic acid (1,3-benzene dicarboxylic acid);
- 5. benzoic acid.

152. The derivative of carboxylic acid is:

- 1. ethanoic acid;
- 2. ethanal;
- 3. chloroethane;
- 4. ethyl alcohol;
- + 5. methyl benzoate.

153. The derivative of carboxylic acid is:

- 1. ethanoic acid;
- + 2. ethanoyl chloride;
- 3. chloroethane;
- 4. benzaldehyde;
- 5. ethanol.

154. The structure of a carboxyl group is characterized by:

- + 1.  $sp^2$ -hybridized carbon and both oxygen atoms formed conjugated system;
- 2.  $sp^2$ -hybridized carbon atom and one of both oxygen, and  $sp^3$ -hybridized another oxygen;
- 3. the linear geometry;
- 4. the absence of conjugated system;
- 5. the tetrahedral geometry.

155. The electronic structure of a carboxyl group provides following reaction centres in carboxylic acid molecules:

- 1. NH-acidic and basic;
- + 2. OH-acidic, electrophilic and *alpha*-CH acidic;
- 3. SH-acidic and nucleophilic;
- 4. OH-acidic and *beta*-CH-acidic;
- 5. only nucleophilic .

156. Acidity of carboxylic acids occurs in reaction centre:



- + 1. OH-acidic;
- 2. NH-acidic;
- 3. nucleophilic;
- 4. electrophilic;
- 5. basic.

157. Water-soluble carboxylic acids are characterized by:

- + 1.  $\text{pH} < 7$ ;
- 2. neutral aqueous solution;
- 3,  $\text{pH} > 7$ ;
- 4. basic aqueous solution;
- 5.  $\text{pH}=7$ .

158. Water insoluble carboxylic acids are dissolved in:

- 1. HCl solution;
- + 2. the alkaline solution and the  $\text{NaHCO}_3$  saturated solution;
- 3. strong acids;
- 4.  $\text{H}_2\text{SO}_4$  solution;
- 5. the NaCl saturated solution.

159. In alkaline solution at room temperature is dissolved:

- 1. methyl benzoate;
- + 2. benzoic acid;
- 3. aniline;
- 4. butyl acetate;
- 5. methyl phenyl ether.

160. Relatively strong acidic properties of carboxylic acids among organic compounds are provided by:

- + 1. high polarity of OH-bond of  $-\text{COOH}$  group and high stability of carboxylate anion;
- 2. low stability of carboxylate anion;
- 3. reactivity of  $\alpha$ -CH-acidic centre;
- 4. low polarity of OH-bond of  $-\text{COOH}$  group;
- 5. electrophilic centre.

161. High stability of carboxylate anion is provided by:

- 1.  $\pi$ - $\pi$ -conjugation;
- + 2. complete delocalization of its negative charge as result of  $p, \pi$ -conjugation;
- 3. conjugated system with closed chain;
- 4. localization of its negative charge on one of oxygen atom;
- 5. aromaticity.

162. The order of carboxylic acids: butanoic  $\rightarrow$  malonic (1,3-propanedioic)  $\rightarrow$  oxalic (1,2-ethanedioic) is characterized by the following order of  $\text{pK}_a$  ( $\text{pK}_{a1}$  for dicarboxylic acids):

- 1.  $1.23 \rightarrow 2.83 \rightarrow 4.81$ ;
- 2.  $4.81 \rightarrow 1.23 \rightarrow 2.83$ ;
- 3.  $2.83 \rightarrow 4.81 \rightarrow 1.23$ ;
- + 4.  $4.81 \rightarrow 2.83 \rightarrow 1.23$ ;
- 5.  $2.83 \rightarrow 1.23 \rightarrow 4.81$ .

163. Functional group carboxylic acids derivatives are formed as the result of the following reactions:

- 1. electrophilic addition ( $A_E$ );
- 2. nucleophilic addition ( $A_N$ );
- + 3. acyl transfer reaction as nucleophilic substitution ( $S_N$ );
- 4. electrophilic substitution ( $S_E$ );
- 5. radical substitution.

164. Functional group carboxylic acids derivatives are formed with participating of the following reaction centre:

- 1. OH-acidic;
- 2.  $\alpha$ -CH-acidic;
- + 3. electrophilic;
- 4. nucleophilic;
- 5. NH-acidic.

165. Thioester is formed as the result of acetic acid reaction with the reagent:

- 1. alcohol/ $H^+$ , t;
- + 2. thiol/ $H^+$ , t;
- 3.  $NH_3$ /t;
- 4.  $SOCl_2$ /t;
- 5.  $PCl_5$ .

166. Product of reaction of butanoic acid with ammonia in prolonged heating is:

- 1. ethylbutanoate;
- 2. butanamine;
- 3. butanoyl chloride;
- + 4. butanamide;
- 5. anhydride of butanoic acid.

167. The reaction of butanoic acid with methanol in heating and presence of acid catalyst results:

- 1. 1,1-dimethoxybutane;
- 2. ethyl propanoate;
- 3. butyl formiate;
- 4. butyl methanoate;
- + 5. methyl butanoate.

168. Acyl transfer reactions of carboxylic acid derivatives occurs in the main reaction centre:

- 1. nucleophilic centre;
- + 2. electrophilic centre;
- 3. NH-acidic centre;
- 4.  $\alpha$ -CH-acidic centre;
- 5. basic centre.

169. Hydrolysis of carboxylic acid derivatives occurs in the main reaction centre:

- 1. basic centre;
- 2.  $\alpha$ -CH-acidic centre;
- 3. NH-acidic centre;
- + 4. electrophilic centre;

- 5. nucleophilic centre.

170. The main product of the reaction of acetyl chloride with dipropylamine is:

- 1. ethyldipropylamine;
- 2. acetamide and 2 mol of 1-chloropropane;
- + 3. N,N-dipropylacetamide;
- 4. N-propylacetamide and 1-chloropropane;
- 5. 2-(N,N-dipropyl)ethanoyl chloride.

171. The reaction of ethyl propanoate with methanamine results:

- + 1. N-methylpropanamide and ethanol;
- 2. propanamide and ethoxymethane;
- 3. ethylmethylpropylamine;
- 4. propanoic acid and ethylmethanamine;
- 5. propanol and N-methylethanamide.

172. Ethyl benzoate may be synthesized by the reaction of benzoyl chloride with the following reagent:

- 1. ethane;
- 2. chloroethane;
- 3. ethanoic acid;
- + 4. ethanol;
- 5. ethylene.

173. The original carboxylic acid is resulted hydrolysis reaction of the following substrate in the neutral water:

- 1. ethyl ethanoate;
- 2. propanamide;
- + 3. ethanoic anhydride;
- 4. butanenitrile;
- 5. acetamide.

174. The original carboxylic acid is resulted acid-catalyzed hydrolysis reaction of the following substrate:

- + 1. ethyl ethanoate;
- 2. propanamine;
- 3. ethane;
- 4. butyl chloride;
- 5. diethyl ether.

175. The base-catalyzed hydrolysis reaction of benzamide is resulted the following products:

- 1. benzoic acid and ammonium salt;
- + 2. benzoic acid salt and ammonia;
- 3. benzene and ammonia;
- 4. phenol and ammonium salt;
- 5. aniline and formic acid salt.

176. In acyl transfer reactions the most reactive is the following acyl compound:

- + 1. ethanoyl chloride;
- 2. ethanamide;

- 3. methyl ethanoate;
- 4. ethanoic anhydride;
- 5. ethanoic acid.

177. In hydrolysis reactions the most reactive is the following compound:

- 1. ethyl chloride;
- 2. ethanamide;
- 3. methyl ethanoate;
- + 4. ethanoic anhydride;
- 5. hexyl thioester of ethanoic acid.

178. The reaction of myristic acid (tetradecanoic acid) with bromine in presence of small amount of red phosphorus results:

- 1. myristyl chloride;
- + 2. 2-bromomyristic acid;
- 3. 3-bromotetradecanoic acid;
- 4. 12-bromotetradecanoic acid;
- 5. tetradecyl chloride.

179. Which of the following compounds will be easily decarboxylated in heating:

- 1. ethanoic acid;
- + 2. oxalic acid (ethandioic acid);
- 3. benzoic acid;
- 4. propanoic acid;
- 5. butanoic acid.

### 9. HETEROFUNCTIONAL COMPOUNDS.

180. The heterofunctional compound is the following:

- 1. oxalic acid;
- + 2. oxaloacetic acid;
- 3. malonic acid ;
- 4. glycerol ;
- 5. sorbitol.

181. The hydroxycarboxylic acid is the following:

- 1. oxalic acid;
- 2. oxaloacetic acid;
- 3. malonic acid ;
- + 4. citric acid;
- 5. valeric acid.

182. The strongest acid is the following

- + 1. 2-hydroxypropanoic acid;
- 2. 3-hydroxypropanoic acid;
- 3. 3-hydroxy-3-methylbutanoic acid;
- 4. 4-hydroxybutanoic acid;
- 5. 4-hydroxy-3-methylbutanoic acid.

183. In the molecules of hydroxycarboxylic acids electron accepting interference of  $\alpha$ -hydroxyl and carboxyl groups increases strength of the following reaction centers:

- 1. basic;
- 2. nucleophilic;
- 3. basic and nucleophilic;
- + 4. OH-acidic and electrophilic;
- 5. no one.

184. Specific reaction of  $\alpha$ -amino acids in mild heating is:

- 1. elimination to give  $\alpha$ -beta unsaturated carboxylic acid;
- 2. formation of lactides;
- 3. formation of lactones;
- + 4. formation of diketopiperazines;
- 5. formation of lactams.

185. In mild heating valine usually forms:

- 1. Lactone and  $H_2O$ ;
- 2. Lactam and  $H_2O$ ;
- 3. Lactide and  $H_2O$ ;
- + 4. Diketopiperazine and  $H_2O$ ;
- 5. 3-methyl-2-butenoic acid and  $NH_3$ .

186. Mild heating of lactic acid (2-hydroxypropanoic acid) lead to formation of:

- 1. Lactone and  $H_2O$ ;
- 2. Lactam and  $H_2O$ ;
- + 3. Lactide and  $H_2O$ ;
- 4. Diketopiperazine and  $H_2O$ ;
- 5. propenoic acid and  $H_2O$ .

187. Heating of lactic acid in presence of concentrated  $H_2SO_4$  lead to formation of the following products:

- 1. methanal and ethanoic acid
- + 2. methanoic acid and ethanal;
- 3. lactone;
- 4. lactide;
- 5. propenoic acid.

188. Gamma-lactone is formed in mild heating of the following compound:

- 1. 2-hydroxybutanoic acid;
- 2. 3-hydroxybutanoic acid;
- + 3. 4-hydroxypentanoic acid;
- 4. 2-aminopropanoic acid;
- 5. 4-aminobutanoic acid.

189. The reaction of 3-aminobutanoic acid in heating results the following products:

- + 1. 2-butenoic acid and ammonia;
- 2. 3-butenoic acid and ammonia;
- 3. lactam and the water;
- 4. diketopiperazine and the water;
- 5. lactide and the water.

190. Diketopiperazines are formed in heating of:

- + 1. 2-aminopropanoic acid;
- 2. beta-alanine;
- 3. 2-aminobenzoic acid;
- 4. 4-aminobutanoic acid;
- 5. 3-aminopentanoic acid.

191. Gamma-lactam is resulted the reaction in mild heating of the following compound:

- 1. 2-aminopropanoic acid;
- 2. beta-alanine;
- 3. 2-aminobenzoic acid;
- + 4. 4-aminobutanoic acid;
- 5. 3-aminopentanoic acid.

192. The oxocarboxylic acid is the following:

- 1. oxalic acid;
- + 2. pyruvic acid;
- 3. malonic acid ;
- 4. citric acid;
- 5. valeric acid.

193. The strongest alpha-CH-acidic centre is present in the molecules of the following oxoacids:

- 1. 2-oxobutanoic acid;
- 2. 2-oxopentanoic acid;
- + 3. 3-oxobutanoic acid;
- 4. 4-oxopentanoic acid;
- 5. 2-oxo-3,3-dimethylbutanoic acid.

194. Decarboxylation reaction occurs in heating in presence of diluted sulfuric acid usually for the following compounds:

- 1. 2-hydroxypropanoic acid;
- 2. 3-hydroxypropanoic acid;
- + 3. 2-oxopropanoic acid;
- 4. 4-aminopentanoic acid;
- 5. 5-hydroxyhexanoic acid.

195. Decarboxylation reaction occurs easy at room temperature usually for the following compounds:

- 1. 2-hydroxypropanoic acid;
- 2. 3-hydroxypropanoic acid;
- 3. 5-hydroxyhexanoic acid;
- 4. 2-oxopropanoic acid;
- + 5. 3-oxobutanoic acid .

196. The reaction of acetoacetic ester with bromine water and following reaction with  $\text{FeCl}_3$  proves:

- 1. pi-pi conjugation;
- + 2. the phenomenon of acetoacetic ester keto-enol tautomerism;
- 3. p-pi conjugation;
- 4. ester group;

- 5. carbonyl group.

197. The derivative of *para*-aminobenzoic acid used as pharmaceutical substance is the following compound:

- +1. procaine;
- 2. isoniazid;
- 3. sulfamethoxypyridazine;
- 4. sulfanilamide;
- 5. methyl salicylate.

198. The derivative of sulfanilic acid used as pharmaceutical substance is the following compound:

- 1. procaine;
- 2. isoniazid;
- + 3. sulfamethoxypyridazine;
- 4. benzocain;
- 5. methyl salicylate.

199. The derivative of salicylic acid used as pharmaceutical substance is the following compound:

- 1. procaine;
- 2. benzocain;
- 3. sulfamethoxypyridazine;
- + 4. acetylsalicylic acid;
- 5. sulfanilamide.

200. The hydroxycarboxylic acid is the following:

- 1. oxalic acid;
- 2. oxaloacetic acid;
- 3. malonic acid ;
- + 4. tartaric acid;
- 5. valeric acid.

201. The oxocarboxylic acid is the following:

- + 1. oxalacetic acid;
- 2. malic acid;
- 3. malonic acid ;
- 4. citric acid;
- 5. valeric acid.