

«APPROVED»



Member of the Management Board,
Vice-Rector for Operations
NJSC «Al-Farabi KazNU»
Duisenov E.E.

2024

10/19/24

**The program of
the entrance exam for the group of educational programs of the Faculty of
Chemistry and Chemical Technology
for master's degree
for foreign citizens to study on a paid basis**

1. General Provisions

1.1 The program was drawn up in accordance with the Order of the Minister of Education and Science of the Republic of Kazakhstan dated October 31, 2018, No. 600 «On approval of the Model Regulations for admission to studies in educational organization, implementing educational programs of technical and vocational education» (hereinafter – the Standard Rules).

1.2. Kazakh National University named after al-Farabi accepts individuals who have completed higher education programs for postgraduate education programs (master's degree).

1.3. Entrance exams are conducted in the form of interviews for the following educational programs:

- ✓ 7M01503 Chemistry
- ✓ 7M05301 Chemistry
- ✓ 7M05318 Chemical Physics (MEPhI)
- ✓ 7M07101 Petrochemistry
- ✓ 7M07103 Chemical Engineering
- ✓ 7M07104 Chemical technology of explosives and pyrotechnics
- ✓ 7M07105 Chemical technology of inorganic substances
- ✓ 7M07106 Chemical technology of organic substances
- ✓ 7M07203 Pharmaceutical production technology
- ✓ 7M07122 Nanomaterials and nanotechnologies in chemistry
- ✓ 7M07121 Nanomaterials and nanotechnologies in chemistry (RUDN)
- ✓ 7M07201 Oil and gas business

1.4. For the organization and conduct of entrance exams for the admission of foreign applicants, an examination subject commission for the academic year is established by the rector of al-Farabi Kazakh National University.

The examination commission for the admission exams of foreign applicants to KazNU includes employees of the Office of Internationalization and Recruitment (hereinafter referred to as the Office) and the teaching staff of KazNU.

1.5. If a foreign applicant who meets the above-mentioned requirements is unable to come to the University for the entrance interview, they have the option to take it in an online format.

1.6. Entrance exams in the form of oral interviews for the admission of foreign applicants

are evaluated on a 100-point scale. For admission to the master's program on a fee-paying basis, a minimum of 75 points is required for the academic and pedagogical track (2 years) and a minimum of 50 points for the specialized track (1-1.5 years).

1.7. Following the entrance interview, a protocol is prepared in the established format. The interview protocol is signed electronically via the "Salem office" system by the chairperson and all attending members of the commission and then submitted to the Office.

1.8. The decision on admission is reviewed by the competition commission for the enrollment of foreign applicants and documented by a protocol through the "Salem office" system. The results of the entrance exam are announced on the day of the exam.

1.9. Retaking the entrance exam is not allowed.

1.10. Appeals regarding the results of the interview are allowed within 24 hours.

2. Conducting the entrance exam in 2024:

2.1 The interview is conducted in Russian, Kazakh, and English languages. The oral interview also includes questions aimed at assessing the applicant's ability to learn, creative activity, critical thinking, and personal qualities.

2.2. An indicative list of interview topics:

I Educational program M013 Training of chemistry teachers

1. Atomic and molecular theory, basic stoichiometric laws.
2. The structure of the atom. The electronic structure of atoms.
3. Periodic law and periodic system of D.I. Mendeleev.
4. Chemical bonding and the structure of molecules.
5. The main patterns of chemical reactions.
6. Water. Solutions. Methods of expressing the composition of solutions.
7. Electrolyte solutions.
8. Properties of acids, bases and salts from the point of view of the theory of electrolytic dissociation.
9. Redox processes.
10. Fundamentals of electrochemistry. Electrochemical activity series of metals.
11. The main provisions of the coordination theory.
12. Dissociation of complex compounds in solutions.
13. General characteristics of organic compounds.
14. Theory of the chemical structure of organic compounds.
15. Classification of organic compounds.
16. General characteristics of saturated hydrocarbons, electronic structure. The nomenclature. Methods of production and their properties.
17. General characteristics of alkenes, electronic structure. The nomenclature. Methods of production and their properties.
18. General characteristics of alkynes, electronic structure. The nomenclature. Methods for the production of alkynes and their properties
19. General characteristics of alkadiens, nomenclature, structure. Methods for the production of alkadiens and their properties.
20. General characteristics of aromatic hydrocarbons. The nomenclature. Methods of obtaining aromatic hydrocarbons and their properties.
21. Methods of teaching chemistry. Learning objectives.

22. Theory and practice of the modern lesson.
23. Chemistry teaching tools and their classification.
24. Pedagogical skills.
25. Modern methods and technologies of teaching chemistry.

II Educational program M089 Chemistry

1. Analytical chemistry, its goals and objectives. The relationship between analytical chemistry and chemical analysis. Analytical control, its goals, and the position occupied in the scheme of the production process.
2. Chemical analysis, and its tasks. The importance of chemical analysis and its fields of application.
3. Methods of chemical analysis. Objects of detection and determination (analyses), their corresponding types of analysis, and Classification of analysis methods. Stages of analysis.
4. Chemical and instrumental methods of analysis. Their classification.
5. Metrological foundations of chemical analysis.
6. Chemical equilibrium in homogeneous and heterogeneous systems.
7. Methods of separation and concentration, their classification. Quantitative characteristics.
8. Atomic structure: main components and their characteristics, quantum mechanical model of the atom
9. Modern ideas about chemical bonds: ionic, covalent, metallic.
10. Periodic table of chemical elements: patterns and trends.
11. Molecular geometry: definition and prediction methods.
12. Acid-base properties of substances: the Brønsted-Lowry and Lewis theories.
13. Types of chemical reactions: analysis and examples.
14. Electrochemistry: redox reactions and electrolysis.
15. Complexation: concept, examples and significance in chemistry.
16. Chemistry of coordination compounds: structure and properties.
17. The theory of molecular polarity: influence on physical and chemical properties.
18. Reactions in solutions: solubility and ionic equilibrium.
19. Chemistry of halogens: properties, applications and reactions.
20. Complex compounds of transition metals: structure and catalysis.
21. Chemistry of oxygen: oxides, hydroxides and acids.
22. Reactivity of inorganic compounds: factors and mechanisms.
23. High energy chemistry. Photochemical and photophysical processes
24. Plasma chemistry and radiation chemistry. Thermodynamics of phase transitions
25. Renewable energy sources
26. Chemical kinetics and carbonation
27. Nucleophilic substitution in an aliphatic series. Mechanisms SN1 and SN2.
28. Nucleophilic substitution at multiple carbon-carbon bonds and in the aromatic ring. Nucleophilic substitution in aromatic heterocycles.
29. Electrophilic substitution at the carbon atom. Substitution mechanisms SE1, SE2, SEi. Orientation rules and their molecular orbital interpretation.
30. Elimination reactions (cleavage). Mechanisms of heterolytic elimination of E1 and E2.
31. Addition via multiple carbon-carbon bonds.
32. Nucleophilic addition to a carbonyl group: addition of bases, including carbanions, and organometallic compounds.

33. Rearrangements in carbocationic intermediates. Classification of rearrangements.
34. Radical and radical ion reactions of addition, substitution and elimination. Chain radical reactions

III Educational program M097 Chemical engineering and processes

1. Chemical technology of basic organic synthesis.
2. Synthesis gas.
3. Production of halogen derivatives.
4. Production of oxiranes
5. Production of alcohols
6. Production of polyalcohols
7. Phenol production
8. Aldehyde production
9. Ketone production
10. Production of carboxylic acids.
11. Production of carboxylic acid anhydrides
12. Production of nitriles and vinyl acetate.
13. Production of amides of carboxylic acids and amines
14. Chemical-technological methods of environmental protection
15. General properties and classification of oil and petroleum products.
16. Arenas and hybrid petroleum hydrocarbons. Unsaturated hydrocarbons formed during oil refining.
17. Thermal transformations of oil hydrocarbons. Thermocatalytic transformations of oil and gas hydrocarbons.
18. Methods for separating oil and gas components.
19. Hydrogenation processes in oil refining. Purification of petroleum products.
20. Kinetics of chemical and phase transformations in the conditions of combustion-explosion transition
21. The brisance and efficiency of energy-intensive materials for practical use in the mining industry
22. General characteristics of physical research methods
23. High energy chemistry. Combustion of condensed systems
24. Flow modes of liquids and gases
25. Movement of liquids and gases
26. Types of heat transfer
27. Mass transfer processes in chemical technology
28. Heat transfer processes in chemical technology
29. Definition of the concept of CTS. Structure, description and analysis of CTS.
30. Classification of variables characterizing the operation of chemical heating systems. Energy technology systems.
31. Energy in chemical production. Types of energy.
32. The main areas of use of water in the chemical industry. Classification of natural waters and characteristics of their impurities. Methods for assessing water quality. Consumer requirements for water quality
33. Production of sulfur dioxide.
33. Roasting of pyrite. Contact method for producing sulfuric acid. Production of mineral salts and fertilizers.

IV Educational program M119 Manufacturing and manufacturing industries

1. Medicinal substances and dosage forms of pharmaceuticals.
2. Classification of synthetic drugs depending on their structure and functional purpose.
3. Medicinal substances of pharmaceutical preparations using the example of hydrocarbons and haloalkanes, their structure, properties and production technology.
4. Medicinal substances of pharmaceutical preparations using the example of alcohols and phenols, their structure, properties and production technology.
5. Technology for the production of pharmacopoeial sulfonamide preparations of the aromatic series, their structure and properties.
6. Technology for the production of pharmacopoeial carboxylic acids, their structure and physicochemical properties.
7. Industrial technology for obtaining substances from medicinal plant materials.

V Educational program M108 Nanomaterials and nanotechnologies

1. Basic concepts and definitions of the science of nanosystems and nanotechnology
2. Nanomaterials, nanoparticles and their classification.
3. Experimental methods of research of nanomaterials and nanostructures
4. Physical and chemical methodologies for the synthesis of nanoparticles

VI Educational program M115 Petroleum Engineering

1. Development of oil and gas fields.
2. Oil and gas extraction.
3. Processing of crude oil and natural gas.
4. Drilling of oil and gas wells.
5. Operation and maintenance of wells and equipment

2.3. Recommended reading list for preparation:

1. Paula Yurkanis Bruis (translation) Fundamentals of Organic Chemistry 1-part, 2013, 2-part 2014 (in Russian).
2. Petrov, A.A... Organic chemistry.- Almaty, 1975 (in Russian).
3. M.K.Beisebekov, J.A. Abilov Organic Chemistry, Almaty, "Kazakh University", 2013, 338c. (in Russian).
4. Shaikutdinov E.M., Torekhanov T.M., Sharipkhanov A.Sh Organikalyk chemistry. Almaty: Bilim, 1999 (in Russian).
5. Utelbaeva A., Utelbaev B. Organikalyk chemistry. Heterofunctionals of kosylystar. Chemistry 5. Almaty, 2007 (in Russian).
6. Eskairov M.E., Azerbaev E.N. Organikalyk chemistry. Almaty: Bilim, 1981 (in Russian).
7. Seitkaliev K. Organic chemistry. Almaty: Kaynar, 1993 (in Russian).
8. K.B. Bazhykova. Alifatty kosylystardyn organikalyk khimiyasy, 2016, 364 b. (in Russian).
9. Patsaev.K. Organikalyk khimiya negizderi. Shymkent, 2005. (in Russian).
10. Seitzhanov N. F. Organikalyk chemistry.- Almaty, 2003 (in Russian).
11. Traven V.F. Organic chemistry.Moscow : Akademkniga, 1,2 2004 (in Russian).
12. Morrison R., Boyd R. Organic Chemistry. Moscow:Mir,HSE, 1990 (in Russian).
13. Turekhanov, T. M. Organikalyk chemical. tandamaly taraulary.- Almaty, 1984 (in Russian).

14. Shabarov, Yu.S. Organic chemistry. - M., 2000 (in Russian).
15. Nesmeyanov, A.N. The beginnings of organic chemistry. - M., 1974 (in Russian).
16. Neyland, O.Ya. Organic chemistry. - M., 1990 (in Russian).
17. J.A. Abilov, K.B. Bazhykova Organikalyk khimiyadan zerthanalyk zhumystar. Almaty, "Kazakh University" 2014 (in Russian).
18. Eshova Zh.T. Himiyalyk technologiyanyn negizgi percentery men apparattary: oku kuraly. – Almaty: Kazakh University, 2007. – 237 b. – 97 dan (in Russian).
19. Lectures on the course "Basic processes and devices of chemical technology": an educational and methodical manual / compiled by: Zh.T. Yeshova, D.N. Akbayeva. – Almaty: Kazakh University, 2017. – 392 p. – 40 dan (in Russian).
20. Kasatkin A.G. Basic processes and devices of chemical technology. – M.: Chemistry, 1973. – 752 p. – 40 copies (in Russian).
21. Krivosheev N.P. Fundamentals of chemical technology processes. – Minsk: Higher School, 1972. – 304 p. – 11 copies (in Russian).
22. Pavlov K.F., Romankov P.G., Noskov A.A. Examples and tasks in the course of processes and devices of chemical technology. – L.: Chemistry, 1987. – 576 p. – 5 copies (in Russian).
23. Romankov P.G., Frolov V.F., Flisyuk O.M. Methods of calculating processes and devices of chemical technology (examples and tasks): Textbook for universities. – 2nd ed., ispr. – St. Petersburg: KHIMIZDAT, 2009. – 544 p. – 1 copy (in Russian).
24. Kayyrbekov ZhK., Aubakirov E.A., Myltykbaeva Zh.K. Zhalpy khimiyalyk technology. , Almaty : Kazakh University: 2009. - 244 bet (in Russian).
25. Kayyrbekov ZhK., Aubakirov E.A., Tashmukhambetova Zh.Kh., Myltykbaeva Zh.K. Zhalpy khimiyalyk technologiyanyn workshops , Almaty : Kazakh University: 2011. - 102 bet (in Russian).
26. Mukhlenov I.P. Fundamentals of chemical technology. M., 1991. – p. 567 (in Russian).
27. Sokolov R.S. Chemical technology. M., 2002-vol. 1-2. – p. 368 (in Russian).
28. Kutepov A.I., Bondareva T.I. General chemical technology. M.:Higher School – 1990. – p. 658 (in Russian).
29. Velikorodov A.V. ORGANIC SYNTHESIS (TEXTBOOK) // International Journal of Applied and Fundamental Research. – 2013. – No. 11-1. – pp. 120-120 (in Russian).
30. Berezin B.D., Berezin D.B. Organic chemistry, part1,2. Moscow: Yurayt, 2020. – 452 p. (in Russian).
31. Kaminsky V.A. Organic chemistry, part 1. M: Yurayt Publishing House, 2019 – 314 p. (in Russian).
32. V.I. Chueshov, E.V. Gladukh, I.V. Saiko. Technology of medicines of industrial production. Part 1. - Vinnytsia: Nova kniga, 2014. -696 p. (in Russian).
33. Loyd V. Allen, A. S. Gavrilov. Pharmaceutical technology. Manufacture of medicines: studies. the manual - M.: GEOTARMed / 2014 512 p. (in Russian).
34. Josep, B.V. Passet, V.Ya. Samarenko, O.B. Schennikov. Chemical technology of pharmaceutical substances: A textbook. St. Petersburg: Lan Publishing House, 2016. 384 p. (in Russian).
35. Iozep A.A. Chemical technology of medicinal substances. The main processes of chemical synthesis of biologically active substances: A textbook. Lan Publishing House, 2016. 356 p. (in Russian).
36. Pharmaceutical development: concept and practical recommendations: [scientific and practical guide for the pharmaceutical industry / ed. Bykovsky S.N. et al.]. - Moscow: Pero,

2015. - 471 p. (in Russian).

37. The State Pharmacopoeia of the Republic of Kazakhstan. - Almaty: Zhibek Zholy, 2008-2014 (1st edition in 3 volumes), 2015-2017 (2nd edition in 2 volumes). (in Russian).

38. Pharmaceutical chemistry: an educational and methodical manual / V.A. Belyaev, N.V. Fedota, E.V. Gorchakov. - Stavropol: AGRUS, 2013. 160 p. (in Russian).

39. Pharmaceutical technology. Manufacture of medicines: studies. manual / Loyd V. Allen, A. S. Gavrilov. - M. : GEOTAR-Media, 2014. -512. (in Russian).

40. Pharmaceutical technology. Technology of dosage forms - Krasnyuk I.I., Mikhailova G.V. - M.: GEOTAR-Media, 2017. - 506 p. (in Russian).

41. Pharmaceutical technology. Textbook in 2 volumes / Krasnyuk I.I., Demina N.B., Anurova M.N. Bunyatyan N.D., Stepanova E.F., Gladyshev V.V., Sysuev B.B., Vernikovskiy V.V. – M.: MIA (Medical Information Agency), 2019. - 256 p. (in Russian).

42. Pharmaceutical technology. Guide to practical exercises / Krasnyuk I.I., Demina N.B., Anurova M.N. - M. GEOTAR-Media, 2019. – 368 p. (in Russian).

43. Gavrilov A.S. Pharmaceutical technology. Textbook. - M.: GEOTAR-Media, 2010. - 624 p. (in Russian).

44. Golovin Yu.I. Introduction to nanotechnology. – M.: Publishing house "Mechanical Engineering -1", 2003. - 112 p. (in Russian).

45. Baloyan B.M., Kolmakov A.G., Alymov M.I., Krotov A.M. Nanomaterials. Classification, features of properties, application and technology of production. - M.: 2014. – 125 p. (in Russian).

46. Sidorov L.N., Yurovskaya M.A., Borshchevskiy A.Ya., Trushkov I.V., Ioffe I.N. Fullerenes: A textbook. Publishing house: "Exam", 2005. – 688 p. (in Russian).

47. Mansurov Z.A., Dinistanova B.K., Kerimkulova A.R., Najipkyzy M./ Nanotechnology negizderi. – Almaty: KR Zhogary oku oryndarynn kauymdastygy, 2014. – 248. (in Russian).

48. Williams L., Adams U. Nanotechnologyalarga kupiyasyz zholkorsetkish. Translators from the English language: Mansurov Z.A., Najipkyzy M., Dinistanova B.K. – Almaty: KR Zhogary oku oryndarynn kauymdastygy, 2012. – 386. (in Russian).

49. Mansurov Z.A. Carbon nanostructured materials based on vegetable raw materials / Almaty, "Kazakh University", 2010 275 p. (in Russian).

50. Mansurov Z.A., Prikhodko N.G., Saveliev A.V. Formation of PCAU, fullerenes, carbon nanotubes and carbon black Almaty: "Kazakh University" 2012. – 379 p. (in Russian).

51. Najipkyzy M., Beisenov R., Mansurov Z.A. Nanomaterials and nanotechnology: A textbook. – Almaty: Kazakh University, 2015. – 262 p. (in Russian).

52. Mishchenko S.V., Tkachev A.G. Carbon nanomaterials. Production, properties, application. M.: "Mechanical engineering", 2008. – 172 p. (in Russian).

53. Harris P. Carbon nanotubes and related structures. New materials of the XXI century. Edited by L.A. Chernozatonsky. Moscow "Technosphere", 2003. – 336 p. (in Russian).

54. Mansurov Z.A., Shabanova T.A., Mofa N.N. Synthesis and technologies of nanostructured materials. Almaty: "Kazakh University", 2012. – 318 p. (in Russian).

55. Golovin Yu.I. Introduction to nanotechnology. – M.: Publishing house "Mechanical Engineering -1", 2003. - 112 p. (in Russian).

56. Baloyan B.M., Kolmakov A.G., Alymov M.I., Krotov A.M. Nanomaterials. Classification, features of properties, application and technology of production. - M.: 2014. – 125 p. (in Russian).

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58. Mansurov Z.A., Dinistanova B.K., Kerimkulova A.R., Najipkyzy M./ Nanotechnology negizderi. – Almaty: KR Zhogary oku oryndarynn kauymdastygy, 2014. – 248. (in Russian).
59. Williams L., Adams U. Nanotechnologyalarga kupiyasyz zholkorsetkish. Translators from the English language: Mansurov Z.A., Najipkyzy M., Dinistanova B.K. – Almaty: KR Zhogary oku oryndarynn kauymdastygy, 2012. – 386. (in Russian).
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66. V.I. Chueshov, E.V. Gladukh, I.V. Saiko. Technology of medicines of industrial production. Part 1. - Vinnytsia: Nova kniga, 2014. -696 p. (in Russian).
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69. Iozep A.A. Chemical technology of medicinal substances. The main processes of chemical synthesis of biologically active substances: A textbook. Lan Publishing House, 2016. 356 p. (in Russian).
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71. The State Pharmacopoeia of the Republic of Kazakhstan. - Almaty: Zhibek Zholy, 2008-2014 (1st edition in 3 volumes), 2015-2017 (2nd edition in 2 volumes). (in Russian).
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74. Pharmaceutical technology. Technology of dosage forms - Krasnyuk I.I., Mikhailova G.V. - M.: GEOTAR-Media, 2017. - 506 p. (in Russian).
75. Pharmaceutical technology. Textbook in 2 volumes / Krasnyuk I.I., Demina N.B., Anurova M.N. Bunyatyan N.D., Stepanova E.F., Gladyshev V.V., Sysuev B.B., Vernikovskiy V.V. – M.: MIA (Medical Information Agency), 2019. - 256 p. (in Russian).
76. Pharmaceutical technology. A guide to practical exercises / Krasnyuk I.I., Demina N.B., Anurova M.N. - M. GEOTAR-Media, 2019. – 368 p. (in Russian).

3. Scale and criteria for evaluating the entrance exam for admission to the master's program (specialized track) for foreign citizens on a fee-paying basis:

Number of points	Compliance criteria
<p>90-100 points «Excellent»</p>	<p>All competencies required for the entrance exam have been mastered. A comprehensive answer has been provided to two theoretical questions:</p> <ul style="list-style-type: none"> - Scientific terminology has been correctly utilized. - All necessary features, elements, grounds, and classifications have been accurately named and defined to substantiate the arguments. - The main viewpoints accepted in scientific literature regarding the discussed issue have been indicated. - Own position or viewpoint has been argued, and the most significant research problems in this field have been identified. - The practical problem has been solved correctly with all necessary explanations.
<p>75-89 points «Good»</p>	<p>All competencies required for the entrance exam have been mastered. A correct answer has been provided to two theoretical questions, with minor deficiencies identified in preparation:</p> <p>Scientific terminology is applied.</p> <ul style="list-style-type: none"> - All necessary features, elements, classifications are named, but there is an error or inaccuracy in the definitions or concepts. - There are shortcomings in argumentation, factual or terminological inaccuracies are present, but they are not significant. - Some insights into possible research problems in the field are expressed. - The practical problem is partially solved with incomplete explanations provided.
<p>50-74 points «Satisfactory»</p>	<p>All competencies required for the entrance exam have been mastered. A correct answer has been provided to two theoretical questions, with minor deficiencies identified in preparation:</p> <ul style="list-style-type: none"> - Only some grounds, features, characteristics of the phenomenon under consideration are named and defined. - Significant terminological inaccuracies are present. - Own viewpoint is not presented. - No insights into possible research problems in the field are provided. - The practical problem is not solved.
<p>0-49 points «Unsatisfactory»</p>	<p>Not all competencies required for the entrance exam have been mastered. Incorrect answers are provided to two theoretical questions, with significant deficiencies identified in preparation. The practical problem is not solved.</p>

3.1 Scale and assessment criteria of the entrance examination for admission to the master's program (academic and pedagogical direction) for foreign citizens on a fee-paying basis:

Number of points	Compliance criteria
<p>90-100 points "Excellent"</p>	<p>Demonstrates knowledge of the fundamental processes within the studied subject area; depth and completeness of addressing the issue; logically and sequentially expresses own opinion on the discussed problem; possesses conceptual-categorical framework, scientific terminology; logical</p>

	coherence of the answer, adherence to the norms of contemporary scientific language.
80–89 points "Good"	Competent use of scientific terminology; mastery of conceptual-categorical framework; problem-oriented presentation of formulated questions; occasional errors in presenting factual material; incompleteness in presenting scientifically established facts within the scope of questions; logical coherence of the answer, adherence to the norms of contemporary scientific language.
75–79 points "Satisfactory"	Insufficient use of scientific terminology; inadequate mastery of conceptual-categorical framework; ability to address only one of the problems formulated in the questions; errors in presenting factual material; superficial knowledge of the subject area; violation of logical coherence in the answer, norms of contemporary scientific language.
0–74 points "Unsatisfactory"	Absence of necessary scientific terminology in the answers; descriptive presentation of discussed issues, inability to identify and present problems; gross errors in presenting factual material; lack of knowledge of historiography of the studied subject area.