

**AL-FARABI KAZAKH NATIONAL UNIVERSITY**  
**Faculty of chemistry and chemical technology**  
**Department of Analytical, colloid chemistry and technology of rare elements**

**Final exam program for the discipline**  
**40670**  
**Chemistry and technology of rare elements**

Educational program:  
"6B05301 - Chemistry"

**Almaty 2023**

Final exam program the discipline is compiled by Madi Abilev, PhD, associate professor of the department of analytical, colloid chemistry and technology of rare elements

Reviewed and recommended at the meeting of the department of analytical, colloid chemistry and technology of rare elements

« 07 » September 2023, Protocol №2

Head of the department \_\_\_\_\_ A.M. Argimbayeva  
(signature)

## Introduction

**Exam format:** synchronous.

**Exam form** – Written exam.

**Exam platform:** Univer IS.

**Exam type** — offline

**Exam control** – lecturer.

**The exam lasts:** 120 minutes for 3 questions, 1 attempt.

**On the exam in this discipline, the following types of questions are encountered**

Knowledge application questions, composite questions.

### Topics for which test tasks will be drawn up

1. The concept of rare elements
2. Technology of rare elements
3. Classification of rare elements. Specific reactions
4. Reserves and deposits of rare elements in Kazakhstan
5. Chemistry and technology of rhenium and molybdenum
6. Chemistry and technology of tungsten and vanadium
7. Chemistry and technology of zirconium and hafnium
8. Analysis of the mixture of rare metals
9. Chemistry and technology of niobium and tantalum
10. Alloys of rare metals
11. Titanium. Technology and application
12. Chemistry and technology of scandium
13. Chemistry and technology of indium
14. Chemistry and technology of lanthanides
15. Chemistry and technology of selenium and tellurium
16. Chemistry and technology of uranium
17. Chemistry and technology of francium and radium
18. Chemistry and technology of lithium, rubidium, cesium
19. Chemistry and technology of beryllium

### Rules for conducting the exam form

The exam will be held according to the exam schedule. The teacher uploads the prepared exam questions to the Univer system (univer.kaznu.kz).

Teacher:

1. In the Univer system, on the tab "Program of final control by subject", places the document "Final control of the discipline" in PDF format, in which the following should be indicated:

- examination rules;
- assessment policy;
- schedule;
- place of examination.

2. After the date of the exam is set in the schedule, the teacher must inform

the students where the rules of the exam are located.

3. Gives time to prepare the answer during the exam.
4. The student is warned about the prohibition of using photocopiers, telephones, and other devices.
5. Monitors the course of training the student, introducing warnings, if necessary, or canceling the student's answer (preparing an act of violation in case of a gross violation of the rules of conduct for the exam). Students are allowed to use the sheet to compose a summary of the answer.
6. After completing the scheduled exam, students' answers are collected and sent to the registrar's office.

### **Student instruction**

1. All students enter the classroom 30 minutes before the exam begins. They show their identity card, sign the exam participation form, and get an exam ticket.
2. Before the exam, students should check whether there is a sheet of paper, a pen and other necessary items.
3. At the beginning of the exam, students turn over the exam ticket and fill in his/her name.
4. Students write their answers to exam questions on the given answer sheet.
5. After completing the exam, students hand over the exam sheet filled with answers to the teacher on duty.

### **Evaluation policy**

As a result of the exam, the student gets 100 points. 30 points for the first question, 35 points for the second question, 35 points for the third question. Within 48 hours, the students' points will be entered in the certification sheet.

### ***Recommended Literature Sources for Exam Preparation***

1. Spellman F.R. The Science of Rare Earth Elements: Concepts and Applications. - CRC Press, 2022.
2. Akcil A. Critical and Rare Earth Elements: Recovery from Secondary Resources. - CRC Press, 2019. – 400 p.
3. Aide M., Nakajima T. Rare Earth Elements and Their Minerals. – Intechopen, 2020. – 102 p.
4. Azimi G., Ouchi T., Forsberg K., Kim H., Alam S. Rare Metal Technology (The Minerals, Metals & Materials Series). – Springer, 2021. – 564 p.
5. Murty Y.V., Alvin M.A., Lifton J.P. Rare Earth Metals and Minerals Industries: Status and Prospects. – Springer, 2023. – 539 p.

**RUBRICTOR FOR CRITERIAL ASSESSMENT OF FINAL CONTROL**  
(for standard oral/written forms)

**Discipline:** 40670 Chemistry and technology of rare elements. **Form:** standard written. **Platform:** offline

№	Score Criteria	DESCRIPTORS				
		«Excellent»	«Good»	«Satisfactory»	«Unsatisfactory»	
		90-100 % (27-30 points)	70-89 % (21-26 points)	50-69 % (15-20 points)	25-49 % (8-14 points)	0-24 % (0-7 points)
<b>Question 1</b> <b>30 points</b>	Describing the chemical properties of the selected element	To give a detailed information about the element, its position in the classification, to describe the principles and mechanisms of the chemical properties.	Some information is missing, but the principles are described correctly.	Basic principles are described, but most of the details are missing (classification, chemical properties, reactions etc.)	The element is classified, but the mechanisms of chemical properties are not mentioned.	The element is classified, no information about chemical properties
	Giving the examples of the application of the element	To give a precise example of application; describe the procedure of separation	Example is good, but no procedure described	Example is given without detailed information	Application of the process is mentioned only for a group of compounds without specific examples	No example
		<b>90-100 % (32-35 points)</b>	<b>70-89 % (25-31 points)</b>	<b>50-69 % (18-24 points)</b>	<b>25-49 % (9-17 points)</b>	<b>0-24 % (0-8 points)</b>
<b>Question 3</b> <b>35 points</b>	Describing the principles of the process	Full information about the components of the instruments is mentioned, including the purpose of each component, types, principles.	The scheme is described correctly, but the components are not fully described.	The scheme is described correctly, but the components are named wrong	Description of the scheme is partially correct, components are named wrong or missing	The process is not identified, components are not named
	Theoretical background for the process	Detailed information on the scheme and application of the process is given	Some information is missing	Some information is missing and application is not given	Most of the theoretical background is missing, no application examples are given	Basic principles are not mentioned, some examples are given
<b>Question 2</b> <b>35 points</b>	Application of selected methodology and calculations to real practical tasks	Completing the study assignment in full, giving a detailed, reasoned answer to the question, and then solving the practical problems. Completing calculations, formulas in them completely and correctly.	Completion of the educational task in part, not completely, giving a reasoned answer to the question posed without fully solving the practical problems; illiterate use of scientific language norms. In calculations, quoting formulas is incorrect or incomplete.	The answer is fragmented, breaking the logical sequence, factual and semantic inaccuracies are allowed, the theoretical knowledge is used superficially.	An irrational method of solving the task or an insufficiently thought-out response plan; inability to solve tasks, perform tasks in general; the presence of errors and shortcomings exceeding the norm.	Inability to use knowledge and algorithms to solve tasks; inability to draw conclusions. Violation of the rules of final control. Practical problem is not solved.

**Formula for calculating the final grade:**

Final grade (**FI**) = (%1+%2+%3+%4+%5+%6, etc.) / **K**, where % is the level of task completion by criterion, **K** is the total number of criteria.

Exam tickets consist of 3 questions. The maximum points for correctly completed tasks are 100, including 30 points for the first question and 35 points for the second and the third questions.

