# AL-FARABI KAZAKH NATIONAL UNIVERSITY

**Faculty of Chemistry and Chemical Technology Department of Physical Chemistry, Catalysis and Petrochemistry**

# Final exam program for the discipline

**FH2211 «Physical chemistry, 1»**

**Educational program:**

# 6B05301 – Chemistry

**Almaty 2022**

The final exam program for the discipline is compiled by the lecturer of the Department of Physical Chemistry, Catalysis and Petrochemistry Supiyeva Zh.A.

Reviewed and recommended at the meeting of the Department of Physical Chemistry, Catalysis and Petrochemistry

at “10” February 2022, protocol No 8

Head of the department \_

(signature)

Ye.A. Aubakirov

# Introduction

**Exam format:** synchronous, i.e. the student takes the exam in real time "here and now

# Exam form:

**Writing** exam.

**Exam platform:** UC Univer.

**Exam type:** offline.

**Exam control:** video monitoring.

**The exam lasts**: 3 hours.

**On the exam in this discipline** the ticket will have 2 tasks (questions).

# Example of exam ticket

1. Characterize basic concepts of the physical chemistry. Assess the first law of thermodynamics, its definitions, analytical formula. Justify your opinion, giving the examples.
2. Critically discuss and provide heat capacity, its dependence on various factors. Assess causes of temperature dependence of the thermal effect of a chemical reaction, Kirchhoff's equation.

# Topics for which test tasks will be drawn up

1.Physical chemistry, methods of its research, basic concepts. The first law of thermodynamics, its definitions, analytical formula. Hess's law, its consequences.

2.Heat capacity, its dependence on various factors. Mayer's equation. Temperature dependence of the thermal effect of a chemical reaction, Kirchhoff's equation.

3.Application of the first law of thermodynamics to various processes involving ideal gases.

4.The second law of thermodynamics, its concepts. Carnot cycle and Carnot's principle. Efficiency of an ideal heat engine. Entropy.

5.Entropy is a criterion for the direction of the process (constructive condition). Equations for calculating the change in entropy in various processes. Planck's postulate.

6.Thermodynamic potentials. Characteristic functions and their natural variables. Comparative characteristics of thermodynamic functions (ΔU, ΔH, ΔS, ΔF, ΔG) as a criterion for the direction of the process.

7.Chemical potential, its relationship with thermodynamic functions and composition of the system. Chemical potential of a component in ideal and real solutions. Activity, activity coefficient.

8.Homogeneous equilibrium, its features and conditions. Isothermal equations of chemical reactions and directions of processes for various homogeneous systems. The law of mass interaction and the equilibrium constant of a chemical reaction.

9.Temperature dependence of the equilibrium constant. Isobaric and isochoric Van't Hoff equations.

10.Phase, components, constituent. Heterogeneous chemical systems, equilibrium conditions in them. Gibbs Phase Rule. Clapeyron-Clausius equation. Description of the state of the water diagram by the Clapeyron-Clausius equation and the Gibbs phase rule. Phase transitions of types 1 and 2, their features.

11.Melting diagram of a two-component system: one-eutectic systems, systems in which components interact chemically (forming compounds with congruent and incongruent melting points). Solid solutions, their formation by penetration and displacement. Melting diagram of solid solutions. Gibbs-Rosebohm Rules I and II.

12.Solubility of two and three liquids in each other. Methods for displaying the composition of a three-component system. Tarasenkov's rule. Crisis melting points. Extraction.

13.Thermodynamic properties of ideal liquid solutions. Real solutions. Raoult's law. Thermodynamic substantiation of the linear dependence of the total and partial vapor pressure on the composition of the system for ideal systems.

14.Boiling point (vapor pressure) - composition (t, P - x) diagrams. Gibbs-Konovalov laws I and II.

15.Ebuliometry. Cryometry. Determination of the molecular weight and molecular state of the solute from cryometric or ebuliometric data. Isotonic Van't Hoff coefficient.

# Rules for conducting the exam:

**3 hours for preparation, after which the work is handed over to the teacher**

# Writing exam: traditional - answers to questions

**Important!** The exam is held according to a schedule that should be known in advance to students and teachers.

The organizer of the exam-conference-the teacher or a member of the exam committee who will take the exam, plans the conference in advance on the selected platform and sends an invitation to the exam participants.

On the day of the exam, for 30 minutes, the teacher reminds students about

the beginning of the exam in the general chat. If necessary, change the communication platform.

# Student instruction

**Important! You must have with you**: **identity card**. In the absence of supporting documents, the student is not allowed to take the exam! If a third party replaces a student, both the student and the third party are brought to disciplinary responsibility.

Carefully read and follow the instructions for passing the exam.

The answer to each examination question should be stated consistently, clearly.

The student has the right to submit an appeal within 24 hours from the moment the grade for the exam in the “Univer” system is set in the event that: the exam ticket contains an incorrect question or a question that does not correspond to the curriculum of the discipline.

**Attention!** The use of headphones FORBIDDEN!

# It is prohibited:

To have with you during the exam unauthorized aids (cribs, cell phones (onor off), smart watches, other electronic devices, etc.).

To make noise, talk, get up and leave the webcam field, premises.

To seek help and provide access to the computer to third parties during the exam.

To look away from the computer screen.

Additionally, to open the tabs of browsers, instant messengers, MO Excel, additional monitors and computer equipment, except for the one that is directly used for the exam.

To use books, drafts, calculators without permission.

To turn off or reduce the level of sensitivity of the microphone to sound during the exam.

# Important!

A student who has committed a violation of any of the above requirements, which was recorded by the act, will be given an “F” (“unsatisfactory”) mark for the discipline.

The opening of unauthorized educational and methodological materials, electronic means of communication in the student during the exam, as well as violation of these Regulations, is the basis for making a decision to cancel the assessment results and give the grade “unsatisfactory”, regardless of whether they were used in the exam or not.

# Imporant!

Questions are automatically generated by the Deputy Dean. The student is prohibited from opening the exam ticket until the teacher-examiner says “You can open your ticket”.

After opening a ticket in the university system, the time countdown begins. The ticket will have 2 tasks (questions).

Read the exam rules carefully and follow them. Answer the teacher’s questions and follow all his instructions.

# Evaluation policy

The ticket will have 2 tasks (questions). The tasks are estimated in sum as 100 points. The 1st task – 50, the second task – 50. The total result will be the sum for all questions of the ticket.

# Recommended literature sources for exam preparation

1. Elements of Physical Chemistry: 6th Edition / P. Peter. Atkins. - Oxford: Oxford University Press, 2013. - 591 p.

2. Physical chemistry: a modern introduction: second Edition / updated and revised by W.M.Davis. - USA: CRC Press, 2012. - 501 p.

3. David W. Ball. Physical Chemistry. USA, Thomson Learning, 2011. 840 p.

4. Peter Atkins,Julio de Paula. Physical Chemistry, Eighth Edition. Oxford University Press, 2006. 1050 p.

5. Robert J. Silbey, Robert A. Alberty, Moungi G. Bawendi. Physical Chemistry. Hamilton Printing, 2005. 944 p.

6. Стромберг А.Г., Семченко Д.П. Физическая химия. М.: Высшая школа,-2003, 527 с.

7. Краснов Г.С., Воробьев Н.К., Годнев И.Н. и др. Физическая химия: в 2-х книгах. М.: Высш.школа, 1995. Кн.1,2.

8. Ira N. Levine. Physical Chemistry. Sixth Edition. New York: McGraw-Hill, 2009. 995 p.

9. Еремин В.В., Каргов С.И., Успенская И.А. и др. Задачи по физической химии. М.: Экзамен, 2005, 318 с.

Internet resources:

1. http://elibrary.kaznu.kz/ru

2. https://www.coursera.org/learn/physical-chemistry

3. https://teach-in.ru/lecture/09-02-Korobov