

AL-FARABI KAZAKH NATIONAL UNIVERSITY
Faculty of Chemistry and Chemical Technology
Department of Physical Chemistry, Catalysis and Petrochemistry

Final exam program for the discipline

FH 3326 «Physical Chemistry, 2»

Educational program:

6B05301 – Chemistry (NIS)

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 _____ Ye.A. Aubakirov
(signature)

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 chemical kinetics. Assess the chemical reaction rate, the influence of various factors on the rate and the basic postulate of chemical kinetics. Justify your opinion, giving the examples.
2. Critically discuss and provide characteristics of electrochemical reactions. Assess causes of electrostatic dissociation, also positive and negative sides of Arrhenius' theory of electrostatic dissociation.

Topics for which test tasks will be drawn up

1. Basic concepts of chemical kinetics. The chemical reaction rate, the influence of various factors on the rate. The basic postulate of chemical kinetics. Average and instant rates. Rate constant, its physical meaning. The mechanism of a chemical reaction, elementary stages, an elementary act of a chemical reaction. Molecularity and order of reaction.
2. Kinetic analysis of simple irreversible reactions of the first, second, n-th (with equal concentrations of reactants) and zero orders. Half-life. Dimension of the different orders reactions rate constants.
3. Integral and differential methods for determining the reaction order and the rate constant of formal-simple reactions in closed systems.
4. The dependence of the reaction rate on temperature. Van't Hoff's rule, temperature coefficient. Arrhenius's law. Activation energy, physical meaning, empirical and true activation energy. Methods for determining the activation energy.
5. The postulates of the independence of the flow of elementary reactions, detailed equilibrium and the limiting stage. Kinetic analysis of a reversible and parallel first-order reaction.

6. Kinetic analysis of consequent reactions. Analysis of kinetic dependences in sequential reactions. Approximate methods of chemical kinetics. Bodenstein's principle of quasi-stationary concentrations.

7. Homogeneous catalysis. Basic properties of the catalyst. Catalytic activity and selectivity. Kinetics of homogeneous catalytic reactions.

8. Heterogeneous catalysis. Adsorption on the catalyst surface. The main stages of a heterogeneous catalytic reaction. Kinetics of heterogeneous catalytic reactions, Langmuir's adsorption theory.

9. Basic characteristics of electrochemical reactions. Causes of electrostatic dissociation. Positive and negative sides of Arrhenius' theory of electrostatic dissociation. Solvation and hydration in electrolyte solutions.

10. Thermodynamic theory of electrolyte solutions. Activity and activity coefficient. Ionic strength of solution, Lewis Randall rule. Debye-Gückel theory of strong electrolytes. Basic concepts of the electrostatic theory of electrolyte solutions. Equations for activity coefficients in the first, second and third approximations, concentration limits of their application.

11. Electrical conductivity of electrolyte solutions. Specific and molar electrical conductivity. Dependence of the electrical conductivity of weak and strong electrolytes on their concentration. Kohlrausch, Debye-Onsager laws. Electrophoretic and relaxation effects of inhibition. Effects of Wine, Falkenhagen.

12. Mobility and transfer numbers, methods of their determination. Electrolysis. Electrolysis laws. Hittorff method. Moving border method.

13. The appearance of a potential jump at the interface. Electromotive force of a galvanic cell (EMF). Nernst equation. Equilibrium and standard electrode potentials. Types of electrodes. Electrodes of the first and second kind. Redox electrodes. Luther's rule. Amalgam and gas electrodes.

14. Types of electrochemical cells. Chemical chains. Thermodynamics of an electrochemical cell. Determination of standard thermodynamic functions and equilibrium constants of electrochemical reactions by the EMF method.

15. Concentration chains with and without charge transfer. Diffusion potential.

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 (on or 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.

Important!

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

7. Ospanova A.K., Seilkhanova G.A. Chemical Kinetics and Electrochemistry [Text] // educational man. Al-Farabi Kazakh National University. - Almaty: Qazaq University, 2017. - 135 p.

8. Seilkhanova G.A., Ospanova A.K. Fundamentals of chemical kinetics and electrochemistry (theory and tests)/Учебное пособие. – Алматы: Unique Service, 2019. – 116 p.

9. Dykstra C. E. Physical chemistry: a modern introduction [Текст]: second Edition / updated and revised by W.M.Davis. - USA: CRC Press, 2012. - 501 p. -). - ISBN 978-1-4398-1077-4