

al – Farabi Kazakh national University
Faculty of chemistry and chemical technology
Department of physical chemistry, catalysis and petrochemistry

Program of final exam on discipline

HKE 2302 «Chemical Kinetics and Electrochemistry»
6B07102 - Chemical Engineering

Almaty 2023 y.

The program of final exam is composed by senior 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

«25» January 2023 y., protocol № 7

Head of department _____ Ye.A.Aubakirov

Introduction

The form of the exam: standard, written

Exam platform: UC “Univer”

Type of exam - offline

Exam control - video cameras in the classroom and a teacher

Duration: 3 hours to answer the questions.

Topics for which assignments will be compiled

1. Basic concepts of chemical kinetics. The rate of chemical reaction, the effect of various factors on the rate. The main postulate of chemical kinetics. Average and instantaneous speeds. Rate constant, its physical value. Mechanism of chemical reaction, elementary stages, elementary action of chemical reaction.
2. Kinetic analysis of simple irreversible reactions of the first, second, nth (with equal concentrations of reactants) and zero order. Half-life. A measure of the rate constant for various order reactions.
3. Methods of determining the order of reactions and determining the rate constant of reactions in closed systems: substitution method, graphical method, Ostwald-Noyes-Rakovsky method, Ostwald's excess method and Van't-Hoff's differential method.
4. Dependence of reaction rate on temperature. Van't-Hoff rule, temperature coefficient. Arrhenius law, equations, assumptions about the effect of temperature on the rate of chemical reactions. Activation energy, physical meaning, experienced and real activation energy. Methods of determining activation energy.
5. Elementary reactions, detailed equilibrium and postulates about the independence of the limiting period. Kinetic analysis of reversible and parallel first-order reactions.
6. Kinetic analysis of chain reactions. Analysis of kinetic relationships in chain reactions. Approximate methods of chemical kinetics. Bodenstein's principle of quasistationary concentration.
7. Homogeneous catalysis. The main 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 the heterogeneous catalytic reaction. Kinetics of heterogeneous catalytic reactions, Langmuir adsorption theory.
9. Basic characteristics of electrochemical reactions. Causes of electrostatic dissociation. Pros and cons of Arrhenius theory of electrostatic dissociation. Solvation and hydration in electrolyte solutions.
10. Thermodynamic theory of electrolyte solutions. Activity and activity ratio. Ionic strength of a solution, Lewis Randall's rule. Debye-Hückel theory of strong electrolytes. Basic concepts of electrostatic theory of electrolytic

solutions. Equations of the first and second activity coefficients and the third approach, concentration limits for their application.

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

12. Mobility and transport numbers, methods of their determination. Electrolysis. Laws of electrolysis. The Gittorf method.

13. Electromotive force (EMF) of a galvanic cell. Nernst equation. Equilibrium and standard electrode potentials. Types of electrodes. Electrodes of the first and second type. 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 using the EMF method.

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

Rules of Exam

The student needs to come to the classroom 20 minutes before the start of the exam and prepare, to sign the attendance sheet and sit in the seat indicated on the attendance sheet. You must have an identity card or ID card, a pen, a pencil with you.

During the exam forbidden:

1. Take and open a ticket without the teacher's permission.
2. To carry unauthorized aids during the exam (cheat sheets, cell phones (turned on or off), smart watches, headphones, other electronic devices, etc.).
3. Make noise, talk, get up and leave the room.
4. Seek help from third parties.
5. Unauthorized use of books, drawings, calculators without the permission of the teacher.

Instruction for the student

Important!

1. A student who has committed a violation of any of the above requirements, which was recorded by the act, is graded "F" ("unsatisfactory") in the discipline.
2. Opening unauthorized educational materials, electronic means of communication with the student during the exam, as well as violation of these Rules is the basis for a decision to cancel the assessment results and give an "unsatisfactory" grade, regardless of whether they were used in the exam or not.

Important!

Assessment policy:

The case – tasks consist of 2 steps and they evaluate by toughly level.

First question – 50 points	Second question – 50 points
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Recommended literature sources for exam preparation

Educational literature: basic:

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, Mounji 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.: Вышш.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>