Exam topics in the Physical Chemistry subject for second-year students of PHARMACY CM, UMK 2024/2025

1. Please formulate an expression for the total differential of the indicated state function (for example: energy, enthalpy, free enthalpy, entropy), interpret the meaning of partial derivatives, provide units and experimental sources of all the quantities mentioned.
2. Please provide units of the following thermodynamic quantities (various examples, e.g. heat of neutralization reaction, specific heat of neutralization products, difference in heat capacities of products relative to substrates, work against barometric pressure, internal pressure, enthalpy of coal combustion, enthalpy of benzene formation, change in internal energy of a pleated skirt during its ironing, changes in the heat capacity of dry ice placed on a laboratory table, change in temperature of water heated by an electric spiral with controlled intensity, order of chemical reaction and quantities defined by formulas).
3. Please verbalize the meaning of the given expression (for example: chemical affinity, chemical affinity of pure components, Hess's law, Kirchhoff's law, Clausius-Clapeyron equation, etc.; physical quantities defined in lectures using formulas).
4. Illustrate the usefulness of linear anamorphosis by providing at least five examples of practical use in physical chemistry.
5. Are internal energy, enthalpy, entropy, heat, heat capacity and work functions of state? Please justify your answer.
6. How much does the change in internal energy differ from the change in enthalpy? Please justify your answer using examples of your choice (alternatively: how much does the change in free energy differ from the change in free enthalpy or how much does the change in chemical affinity determined in isothermal-isochoric conditions differ from that determined in isothermal-isobaric conditions). 7. What thermodynamic stimuli affect the value of chemical affinity and the chemical affinity of pure components along with the course of a chemical reaction? Justify your answer graphically with the course of changes as a function of time.
8. Using the mathematical form of the van't Hoff isobar and the Claussius-Clapeyron equation, explain the influence of factors on the conditions of freezing and boiling water.
9. Does the equilibrium constant depend on temperature (on pressure)? Please justify your answer using an example of your choice (given).
10. For the given example, convert the equilibrium constant expressed in non-thermodynamic form to thermodynamic form. Interpret the units of the equilibrium constant.
11. Provide methods for measuring the chemical affinity constant and the chemical affinity of pure components.
12. Are the temperature and pressure of the phase transition independent? Please justify your answer using the example of the phase diagram of water and the Claussius-Clapeyron equation.
13. What is the number of degrees of freedom in the given thermodynamic systems (various examples)?
14. How can the value of the order of a chemical reaction, the value of the chemical reaction rate constant and the activation energy be experimentally determined?
15. Why do different reactions usually have different rates, different half-lives, different values of equilibrium constants, and heats of reaction?
16. Illustrate the utility of thermal distillation of liquids exhibiting limited miscibility. Can a homogeneous mixture be distilled and an inhomogeneous distillate obtained? Please justify your answer.
17. Please explain what the azeotropic point and eutectic point are.
18. What are logP and logD and what is their significance in pharmaceutical sciences?
19. Write and interpret the kinetic equation of complex reactions (for example: reversible, consecutive, parallel, parallel with one reversible step, consecutive with two reversible steps...)
20. Graphically illustrate the Michaelis-Menten model describing the kinetics of enzymatic processes. Please provide the physical meaning of the Michaelis constant and the maximum rate. How can these values be measured experimentally?
21. How does ionic conductivity (equivalent, specific, molar, limiting) change with concentration?
22. How can the value of the indicated thermodynamic quantities (for example: solubility product values, complexation constant, dissociation constant, degree of dissociation, ...) be determined using conductometric measurements?
23. Sketch and interpret the course of a titration of your choice, e.g. alkalimetric, (or acidimetric, precipitometric, complexometric, redoximetric) using conductometric measurements.
24. What will be the electrolysis products and what will remain in the electrolyzer if the given electrolyte solutions are electrolyzed (various examples)? In particular, how will the course of electrolysis affect the pH value of the near-cathode, near-anode and total areas? What will remain in the electrolyzer after a very long electrolysis.
25. What is SEM? Does its value change during the course of electrode reactions?
26. In which direction do electrode reactions proceed? (various examples including biological oxidation)