CONTROL AND MEASURING DEVICES

Questions of the border control program 1

OP: 6B10115-"Medicine"

Discipline Code: Him 1202

Discipline: "Chemistry"

Amount of study hours/ credits: 120h/4k

Course 1 Semester I
The originator:
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1. What does thermodynamics study? Basic concepts used in chemical thermodynamics.
2. The first and second laws of thermodynamics. The relationship of system parameters (temperature, internal energy, enthalpy, free energy, entropy) with living matter.
3. Thermochemistry. Heat capacity. Thermochemical calculations and their use of energy characteristics in biochemical processes. Thermal effects. Hess's law.
4. What does kinetics study? The reaction speed. The dependence of the reaction rate on various factors. The law of the acting masses. The Van't Hoff rule.
5. Forecasting the shift of chemical equilibrium. Concepts of the kinetics of biological processes in living organisms.
6. What is the activation energy? The Arrhenius equation.
7. The effect of catalysts on the reaction rate. The biological role of acid-base and enzymatic catalysis.
8. General concepts of solutions. The importance of solutions in the vital activity of organisms. Electrolytes in a living organism.
9. Ways of expressing the composition of the solution.
10. Solubility and its dependence on various factors. The laws of Henry and Sechenov.
11. Colligative properties of solutions. What is osmosis and osmotic pressure? Osmotic Van't Hoff equations.
12. The role of osmosis in biological processes.
13. Vapor pressure above the solution and Raoul's law.
14. Hypo-, hyper- and isotonic solutions in medicine. Plasmolysis and hemolysis.
15. Increasing the boiling point and lowering the crystallization temperature of the solution. Give the calculation formulas. Ebuliometry. Cryometry.
16. Theory of acids and bases (Arrhenius, Brensted-Lowry). Definitions of acid and bases.
17. The main provisions of the protolytic theory of acids and bases
18. Electrolytic dissociation. The constant and degree of dissociation. Herald's law of breeding.
19. Ionic product of water. Hydrogen and hydroxyl indicators.
20. Types of acid-base balance disorders. Types of acidosis and alkalosis.
21. Homeostasis. Violations of the acid balance of the blood.
22. Which solutions are called buffer solutions. The mechanism of buffering action.
23. Calculation of pH and determination of buffer capacity of buffer systems.
24. Blood buffer systems. Acid-base balance of biological fluids.
25. The importance of buffer systems in the human body
26. What is hydrolysis? Explain the main cases of salt interaction with water.
27. Hydrolysis reactions.
28. Factors influencing the degree of hydrolysis.
29. Different types of salts and how each of them is hydrolyzed.
30. The biological role of hydrolysis in biochemical processes.
31. Biologically significant elements. Biogenic s, p, and d elements and their biological role.
32. Forms of the presence of biogenic elements in the human body. What chemical elements are found in a living organism?
33. Classification of biogenic elements depending on the content, that is, the mass fraction of elements (%) in the human body?
34. The medical and biological significance of s-elements and their compounds.
35. The medical and biological significance of p-elements and their compounds.
36. The medical and biological significance of d-elements and their compounds.
37. Which elements belong to macro-, micro-, and ultramicroelements?

38. Endemic diseases and human microelementoses.
39. Complex compounds and their properties. The biomedical role of complex compounds.
40. The structure of complex compounds. The nature of the chemical bond between ligands and the complexing agent. Obtaining complex compounds.
41. Biocomplexes. Understanding of the structure of metalloenzymes (hemoglobin, chlorophyll) and their biological role.
42. The use of complex compounds in medicine.
43. The essence and direction of redox reactions. Electrode potentials. The Nernst equation.
44. The importance of redox processes in medicine. Potentiometry in medical practice.
45. Galvanic cells. Electromotive force (EMF) of a galvanic cell.
46. The use of potentiometry methods in clinical analysis and in the practice of sanitary and hygienic research.
47. Surface phenomena at the interface of phases. Gibbs energy. Surface tension.
48. Surfactants and surfactants.
49. Surface energy. The Duclos-Traube rule.
50. Adsorption. Gibbs adsorption isotherm equation. The Langner and Freundlich equations. Biological significance of adsorption processes. Adsorption therapy is used in medicine.
51. Chromatographic measurements and their application in medicine.
52. The emergence and development of chromatography. Classification of chromatographic methods.
53. Colloidal-dispersed system. Properties of dispersed systems. Classification and production methods.
54. Molecular kinetic and optical properties of colloidal solutions.
55. The structure of a colloidal particle (micelle).
56. Electrophoresis and electroosmosis. Applications in medicine.
57. Methods of purification of colloidal solutions. Sedimentation analysis.
58. Stability and coagulation of colloidal systems, its medical and biological significance. The Schulze-Hardy rules.
59. Features of IUD solutions. Swelling.
60. Factors influencing swelling, the biological significance of swelling. Salting, hardening. Syneresis.

Tasks

1. Find the volume of 2h H_2SO_4 solution (ml) required to prepare 250ml of 0.1 n.
2. Find the mass fraction of glucose in a solution containing 280 g of water and 40 g of glucose.
3. Calculate the mass of potassium permanganate to prepare a 50g 5% solution.
4. Calculate the mass fraction of sodium chloride in a solution containing 80 g of H_2O and 20 g of NaCI.
5. How many grams of Na_2CO_3 is contained in 500 ml of 0.25n solution?
6. Density of 9% solution (by weight) sucrose solution $C_{12}H_{22}O_{11}$ is equal to 1.035 g/ml. Calculate the molarity and molality of the solution.
7. Calculate the molar fractions of alcohol and water in 96% (by weight) solution of ethyl alcohol.
8. What volume of 0.1n solution contains 8g of $CuSO_4$?

9. What is the molar concentration of the solution if 1 liter of the solution contains 20 g of NaOH.

10. Calculate the equivalent concentration of sulfuric acid solution when 4.9g of H_2SO_4 is dissolved in 250 ml of solution.

11. Find the mass of sodium nitrate required to prepare 200 ml of 0.5 n solution.

12. Determine the thermal effect of the combustion reaction of methane $CH_4(g)+ 2O_2(g)= CO_2(g)+ 2H_2O(g)$, if the thermal effects of formation are respectively: -74.9; -393.5; -241.8 kJ/mol.

13. Calculate the value of ΔH^0_{298} for glucose conversion reactions occurring in the body: $C_6H_{12}O_6$ (s) = $2C_2H_5OH$ (l) +$2CO_2$ (g)if ΔH0= -1273.0; -277.6; -393.5 kJ/mol.

14. 14. Calculate the value of ΔH^0 for the glucose conversion reactions occurring in the body: $C_6H_{12}O_6$ (s) + $6O_2$= $6CO_2$ (g)+ $6H_2O$(l) if ΔH^0 = -1273.0; -393.5; - 285.8 kJ/mol.

15. Calculate the Gibbs energy for iron (II) oxide during magnesium reduction: ΔG_{FeO}= -244,3 kJ/mol., ΔG_{MgO} = -635,6 kJ/mol.

16. Calculate the Gibbs energy for copper (II) oxide during hydrogen reduction: ΔG_{CuO}= -129,9 kJ/mol., ΔG_{H2O} = -273,3 kJ/mol.

17. Calculate the thermal effect of the copper oxide reaction during reduction by calcium if ΔH^0_{CuO}= -162,0 kJ/mol., ΔG_{CaO} = -635,5 kJ/mol.

18. Without performing calculations, find the sign of entropy for the process: $N_{2(г)} + 3H_{2(г)} \rightarrow 2NH_{3(г)}$

19. Without performing calculations, find the sign of entropy for the process: $2CO(г) + O_2(г) \rightarrow 2CO_2(г)$

20. The concentration of $[H^+]$ in the solution is 10^{-8}, its pH value will be equal to.

21. Calculate the pH of solutions in which the concentration of OH^- ions (mol /l) is equal to a) $2{,}7\cdot10^{-10}$, b) $5\cdot10^{-4}$.

22. Calculate the pH of 0.01 n acetic acid solution, in which the degree of dissociation is 0.042.

23. Calculate the pH of 0.01 n formic acid solution, in which the degree of dissociation is 0.1.

24. The temperature coefficient of the reaction rate is γ = 3, with an increase in temperature by 400°C. how much will the rate of the chemical reaction increase?

25. How will the reaction rate of $2NO (g)+O_2(g) =2NO_2(g)$ change if the system pressure is increased 3 times?

26. The temperature coefficient of the reaction rate is equal to γ = 2, with an increase in temperature by 500°C. How much will the rate of the chemical reaction increase?

27. Calculate the pH of 0.02M NH_4OH solution ($Cd = 1{,}8\cdot10^{-5}$).

28. Calculate the pH of 0.01N CH_3COOH solution ($Cd = 1{,}8\cdot10^{-5}$).

29. What is the osmotic pressure of 0.5 m glucose solution $C_6H_{12}O_6$ at a temperature of 25^0C?

30. Calculate the osmotic pressure of a solution containing 16 sucrose ($C_{12}H_{22}O_{11}$) in 350 g of water at a temperature of 293 K. The density of the solution is considered equal to unity.

31. Calculate the osmotic pressure of 0.9% NaCl solution. The density of the solution is considered equal to unity.

32. How many degrees will the boiling point rise if 9 g of glucose is dissolved in 100 g of water (E = 0.52).
33. At what temperature will 50% (by weight) boil sucrose solution ($C_{12}H_{22}O_{11}$), E=0,52.
34. At what temperature will 40% crystallize (by weight) a solution of ethyl alcohol C_2H_5OH (K=1,86).
35. When 5.0 g of the substance is dissolved in 200 g of water, a non-conductive solution is obtained that crystallizes at -1.45^0C. Find the molecular weight of a substance (K=1,86).
36. How many grams of glucose should be dissolved in 100 g of water to lower the crystallization temperature by 1 degree (K=1,86).
37. How many grams of sucrose should be dissolved in 100 g of water to raise the boiling point by 1 degree (E=0,52).
38. Find the boiling point of a solution containing 65 g of sucrose in 250 g of water (E=0,52).
39. When 13g of nonelectrolyte was dissolved in 400g of diethyl ether, the boiling point increased by 0.453K. Determine the molecular weight of the solute (E=2,02).
40. The boiling point of an aqueous solution of sucrose $C_{12}H_{22}O_{11}$ is 101,4ºC. Calculate the molar concentration and mass fraction of sucrose in solution. At what temperature does this solution freeze?
41. The concentration of sodium chloride in the environment surrounding the cell at which hemolysis begins is a measure of the osmotic resistance of red blood cells. In human red blood cells, hemolysis begins in a 0.4% sodium chloride solution, and in a 0.34% solution, all red blood cells are destroyed. What is the osmotic pressure of these solutions at 37°C?
42. Calculate the mass of sodium chloride and water required to prepare 500 g of isotonic solution. What is a solvent, a dissolved substance in a given solution? What is the mass fraction of sodium chloride in hypo- and hypertotic solutions relative to blood plasma? What happens when a red blood cell is placed in a hypertonic solution?
43. Preparations containing manganese (II) sulfate are used as hemotosis stimulants, contributing to the development and formation of red blood cells. Calculate the volume of a solution with a molar concentration equivalent to 0.01 mol/l containing 1.51 g of $MnSO_4$. Molar concentration of the equivalent (definition, formulas for calculation, designations and units of measurement of quantities).
44. Calculate the pH of a buffer solution consisting of 0.5 m CH_3COONa and 1m CH_3COOH (pK=4,75).
45. Calculate the pH of a buffer solution consisting of 19ml 0.1m NH_4OH and 10ml 0.01m NH_4CI (pK =4,75).
46. Calculate the pH of a buffer solution consisting of 0.2 m $NaHCO_3$ and 1m Na_2CO_3 (pK=10,3).
47. Calculate the pH of a buffer solution consisting of 10ml 0.01n HCOONa and 10ml 0.02n HCOOH (pK=3,75).
48. Find the buffer zone if the phosphate buffer pK=7,2.
49. In what ratio are the initial components of the phosphate buffer system in blood plasma at a pH of 7.36, if for blood plasma $pK(H_2PO_4^-) = 6,80$?
50. To 100 ml of blood, 36 ml of 0.05 n HCl solution should be added to change the pH from 7.36 to 7.00. Calculate blood buffer capacity by acid.

51. Calculate the buffer capacity of blood serum (mol/l) by acid if, when adding 2 ml of hydrochloric acid with a concentration of 0.8 mol/l to 50 ml of serum, the pH changed from 7.3 to 7.0. What role do protolytic buffer solutions play in the body? List the acid buffer systems of the body and indicate their composition.

52. An ammonia buffer solution is functioning in the kidneys. Specify its composition and calculate the pH of the buffer solution containing 3.6 ml of 0.2n ammonium chloride solution and 2.3 ml of 0.1n ammonium hydroxide solution ($K_b=1{,}74\cdot10^{-5}$). What reaction confirms that when a small amount of a strong base is added, the pH of the ammonia buffer solution does not change.

53. When determining albumin by reaction with bromocresol green, an acetate buffer solution is used to create a certain acidity of the medium. Explain why adding a small amount of a strong acid or a strong base does not change the pH of the medium (using the reaction equations). Calculate the pH of an acetate buffer solution prepared by mixing 50 ml of 0.050n acetic acid solution ($K_a=1{,}74\cdot10^{-5}$) and 30 ml of 0.1n sodium acetate solution.

54. When studying the activity of transferazdinitrophenylhydrazine, a phosphate buffer is used. To prepare it, mix 840 ml of a solution of sodium hydrophosphate with a concentration of 0.1 mol / l and 160 ml of a solution of potassium dihydrogen phosphate of the same concentration. Find the pH of the buffer solution ($K_a=6{,}16\cdot10^{-8}$). What is a protolytic buffer system? What role do such systems play in the body?

55. The bicarbonate buffer system is the main buffer system of blood plasma. Its buffer capacity is 70-80% of the total buffer capacity of blood plasma and other extracellular fluids. Give the composition and explain the mechanism of action of the bicarbonate buffer solution (molecular, complete and abbreviated ionic equations of reactions). What acid buffer solutions are there in the body?

56. Deviation of blood pH from its normal value of 7.38 by only a few hundredths of a unit causes general malaise and noticeable changes in the course of various physiological processes. An increase or decrease in blood pH by 0.2-0.3 units can lead to a comatose state, and with deviations of the order of 0.3-0.4 units, a fatal outcome is very likely. Calculate the pH of the blood serum if the concentration of hydrogen ions is $4{,}5\cdot10^{-8}$ mol/l.

57. Write hydrolysis reactions $Cu(NO_3)_2$, K_2SO_3, NH_4CN, NaCl, KNO_3, $ZnCI_2$, NH_4CH_3COO, Na_3PO_4.

58. Make up the ionic-molecular and molecular equations of the hydrolysis of a salt, the solution of which has: a) an alkaline reaction; b) an acidic reaction.

59. What is the pH value (> 7 <) of solutions of the following salts: K_3PO_4, $Pb(NO_3)_2$, Na_2S? Make up the ion-molecular and molecular equations of hydrolysis of these salts.

60. Which of the salts of K_2CO_3, $FeCl_3$, K_2SO_4, $ZnCl_2$ undergo hydrolysis? Make up the ion-molecular and molecular hydrolysis equations of the corresponding salts. What is the pH value (> 7 <) of solutions of these salts?

61. Potassium chloride is used for hypokalemia, which occurs with vomiting, diarrhea, and prolonged use of diuretics. Calculate the mass of potassium chloride contained in 0.5 liters of its 0.3 M solution. Potassium is a macronutrient. Describe its biological role.

62. Magnesium sulfate solutions are used as vasodilating (vasodilating) agents. Calculate the volume of 0.02 n magnesium sulfate solution, which contains 18 g of salt. Define the concepts: macro- and microelements, organogens. Which of them relate to macronutrients? Describe the biological role of magnesium and calcium.

63. Write the names of the compounds, determine the coordination number, the degree of oxidation of the complexing agent, and the charge of the complex ion in these complex compounds.:
a) $K[AgBr_4]$ b) $[Cd(NH_3)_4](OH)_2$
64. Write the names of the compounds, determine the coordination number, the degree of oxidation of the complexing agent, and the charge of the complex ion in these complex compounds.:
a) $Cu_2[Fe(CN)_6]$ b) $H[Co(CN)_4(H_2O)_2]$
65. Write the names of the compounds, determine the coordination number, the degree of oxidation of the complexing agent, and the charge of the complex ion in these complex compounds:
a) $K[Pt(NH_3)Cl_5]$ b) $K_3[Co(NO_2)_6]$
66. Write the names of the compounds, determine the coordination number, the degree of oxidation of the complexing agent, and the charge of the complex ion in these complex compounds:
a) $Na_3[Ag(S_2O_3)_2]$ b) $Ba[Cu(SCN)(CN)_3]$
67. Write the names of the compounds, determine the coordination number, the degree of oxidation of the complexing agent, and the charge of the complex ion in these complex compounds.:
a) $[Cr(NH_3)_4(H_2O)_2]Br_3$ b) $Na_3[Co(H_2O)_6]$
68. Find the degree of oxidation of the complexing agent in the compound $K[Co(H_2O)_2(CN)_4]$.
69. Find the degree of oxidation of the complexing agent in the compound $(NH_4)_2[Fe(SO_4)_2]$.
70. If the electrode is lowered into a solution with pH = 10, then the potential of the hydrogen electrode φ is equal to what?
71. If the electrode is lowered into a solution with pH = 3, then the potential of the hydrogen electrode φ is equal to what?
72. When $KMnO_4$ and KI interact, a brown MnO_2 precipitate is formed at a pH of?
73. When $KMnO_4$ and KI interact, a precipitate of K_2MnO_4 is formed at a pH of?
74. Calculate the electrode potential of an iron electrode at a $FeSO_4$ concentration of 0.01 M if φ^0Fe^{2+}/Fe=-0,44B.
75. Calculate the electrode potential of a copper electrode at a concentration of 0.01 M of CuSO4 if φ^0Cu^{2+}/Cu=0,34B.
76. What is the potential of the hydrogen electrode at a) pH=7 b) pH=5 c) pH=10.
77. Colloidal solution of iron (III) hydroxideobtained by the reaction: $FeCl_3 + 3NaOH = Fe(OH)_{3(s.)} + 3NaCl$. With some excess of a) $FeCl_3$, b) NaOH. Draw up a diagram of the structure of the micelle of iron (III) hydroxide sol for cases a) and b). Determine the charge sign of the colloidal particles.
78. Which sols: iron(III) hydroxide (with an excess of $FeCl_3$), silver iodide (with an excess of $AgNO_3$), silver iodide (with an excess of KI), should be mixed so that mutual coagulation occurs?
79. A colloidal solution of silver iodide was obtained by the reaction: $KI + AgNO_3 = AgI + KNO_3$. With a certain excess of KI. It is coagulated with solutions of sodium sulfate and calcium acetate. Which electrolyte has a higher coagulating capacity?
80. Micelles of saliva are an example of a lyophobic colloidal particle, the aggregate of which is the smallest crystals of insoluble calcium phosphate. Schematically imagine the structure of the micelle, considering sodium phosphate as a stabilizer. What factors influence the stability of a

colloidal particle? What is coagulation? Compare the coagulating effect on the above sol of solutions of sodium chloride and calcium chloride of the same concentration.

81. In pharmaceutical practice, collargol is prepared in the presence of protective colloids. Make up the formula of the silver iodide sol micelle if potassium iodide plays the role of stabilizer. Describe the structure of the micelle.

82. Coagulation of 4 liters of iron (III) hydroxide sol occurred with the addition of 0.91 ml of a 10% solution of magnesium sulfate (density 1.1 g/ml). Calculate the threshold of sol coagulation by sulfate ions.

83. The threshold for coagulation of aluminum hydroxide sol by dichromate ions is 0.63 mol/l. What volume of 10% potassium dichromate solution (density 1.07 g/ml) is required for coagulation of 1.5 liters of sol?

84. Coagulation of 1.5 liters of gold sulfide sol occurred with the addition of 570 ml of 1.5% sodium chloride solution (density 1.02 g/ml). Calculate the threshold of sol coagulation by sodium ions.

85. Write formulas for micelles of sols: barium carbonate stabilized with barium chloride.

86. Write formulas for micelles of sols: silver bromide stabilized with silver nitrate.

87. Write the formulas of micelles of sols: iron (III) hydroxide obtained by hydrolysis.

88. Write the formulas of micelles of sols: iron (III) hydroxide obtained by the method of adsorption peptization; peptizer – ferric (III) chloride.

89. Write the formulas of micelles of sols: iron (III) hydroxide obtained by chemical peptization; peptizer – hydrochloric acid.

90. Write formulas for micelles of sols: Prussian blue stabilized with ferric chloride (III).

91. Write formulas for micelles of sols: Prussian blue stabilized with potassium hexacyanoferrate (II).

92. Write formulas for micelles of sols: lead (II) chloride, stabilized with potassium chloride.

93. Write formulas for micelles of sols: barium sulfate stabilized with potassium sulfate.