AL-FARABI KAZAKH NATIONAL UNIVERSITY

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COLLOID CHEMISTRY.
MULTIPLE CHOICE QUESTIONS

Educational manual

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The educational handbook includes multiple choice questions (MCQ) on colloid chemistry that could be applied for preparation to midterms, control works and exams. Multiple choice questions cover all subjects of colloid chemistry and interfacial phenomena and MCQ were prepared based on lectures on colloid and surface science. The educational handbook will be useful for bachelor students of specialties “Chemistry”, “Chemical Technology of Organic Substances”, “Chemistry”, “Technology of pharmaceutical production”, master students of Faculty of Chemistry and Chemical Technology.

INTRODUCTION

Colloid Chemistry describes the features of substances in colloidal state and studies the coarse and fine disperse materials.

Modern Colloid Chemistry studies the physico-chemistry of disperse systems and surface phenomena. According to their sizes, the colloid systems occupy the intermediate region between molecules (atoms, ions) and macroscopic objects (macrophases). Size of dispersed particles range from 1 nm to 100 μm.

The dispersed state and surface or interfacial phenomena can not be separated from each other, as interfacial phenomena determine the characteristic properties of disperse systems as well as the means by which one can control such properties.

The specific peculiarities of disperse systems are **dispersion, heterogeneity and istability.**

Heterogeneous systems (microheterogeneous systems) consists of two or more phases in which at least one phase is present in the dispersed state, are called to as **disperse systems**.

Here are presented briefly some highlights of colloid chemistry.

The **degree of dispersion** is determined as the ratio of the total surface area of particles forming the dispersed phase (at the interface between the dispersed phase and the dispersion medium) to the total volume of these particles.

For the monodisperse system consisting of uniform spherical particles of radius r, one can write that $D = 3/r$; for systems consisting of particles of another shapes than spherical the inverse proportionality between dispersion and the particle size will be maintained with a different numerical coefficient.

Disperse system is characterized as an ensemble of particles of **dispersed phase**, surrounded by the **dispersion medium**.

The **specific surface area** is defined as the ratio of the total surface area of all particles to the total mass of these particles, i.e. $S_{sp} = S/m$, or to the total volume $S_{sp} = S/V$.

The principal peculiarity of fine disperse systems is the presence of highly developed interfaces. These interfaces and the interfacial phenomena occurring at them affect the properties of disperse systems, primarily due to the existence of excessive surface (interfacial) energy associated with interfaces.

The excessive interfacial energy is the reason for the higher chemical and surface activity of dispersed phases in comparison with macroscopic phases. Therefore, disperse systems are differed by surface phenomena such as **adsorption**, **wetting**, **adhesion** etc.

Classification of disperse systems:

1. Based **on the aggregate state of dispersed phase** and dispersion medium - are classified into eight types (gas in gas is not a colloid, it is a mixture)
2. Based **on nature of interaction between dispersed phase and the dispersion medium** (**lyophilic and lyophobic systems**).
3. Based **on size of dispersed phase partices (fine dispersed and coarse dispersed systems)**

4. Based on stucture of of dispersed phase partices (**free dispersed and structured dispersed systems**)

Substances that lower the surface tension of the solvent are referred to as **surface active agents, or surfactants**. It follows from the Gibbs equation that the adsorption of such compounds is positive, i.e. their concentration within the surface layer is higher than that in the bulk.

Molecules of surfactants contain polar group and nonpolar group. Amphiphilic molecules consisting of a hydrophobic (lyophobic) and hydrophilic (lyophilic) parts.

They are classified according to the nature of the head polar group: anionic, cationic, amphoteric (zwitterionic), and nonionic.

Anionic surfactants are organic compounds which upon dissociation in water produce large anions containing hydrocarbon chain. These anions are the "carriers" of the surface activity, while cations are not surface active at the air-solution interface. Examples of anionic surfactants: Carboxylates: $C_nH_{2n+1}COO^- \ X^+$, Sulfates: $C_nH_{2n+1}OSO_3^- \ X^+$, Sulfonates: $C_nH_{2n+1}SO_3^- \ X^+$, Phosphates: $C_nH_{2n+1}OPO(OH)O^- \ X^+$.

Cationic surfactants, when dissociated in water, yield developed organic cations, which are the "carriers" of the surface activity. Primary, secondary and tertiary aliphatic and aromatic amines, quaternary ammonium salts and pyridine derivatives all represent common examples of cationic surfactants:

Fatty amines can be synthesized by reacting alkylhalides with either ammonia or lower amines, from fatty acids and their derivatives (i.e., amides and ammonium salts), or by ammonolysis of fatty alcohols. Amines dissociate and reveal surface activity primarily under acidic conditions. Higher homologs, such as octadecylamine, are insoluble in water, but soluble in oil.

Quaternary ammonium salts, $[RN\ (R\ ')\ 3]^+ X^-$, where R are C_{12} -C_{18}; R 'is CH_3, or C_2H_5, and X^- is usually $C1^-$ or Br^-, are obtained by reacting higher aliphatic amines with alkylhalides, or by reacting long-chain alkyl halides with lower tertiary amines. Pyridinium salts $[C_5H_5NR]^+Br^-$.are obtained by reacting pyridine with alkyl halides.

Amphoteric surfactants are compounds containing both acidic (usually carboxylic) and basic (usually amino-group substituted to different degrees) functional groups in their structure. Depending on the ambient pH, these surfactants behave as cationic (pH <4) or anionic (pH 9 - 12). Within the pH range between pH 4 and pH 9, amphophylic surfactants behave as nonionic compounds. Many natural compounds, including all aminoacids and proteins, belong to this group of surfactants.

Examples of synthetic analogs of such substances include alkylaminoacids, e.g. cetylaminoacetic acid, $C_{16}H_{33}NH\text{-}CH_2COOH$. These compounds are, however, costly and difficult to prepare, and thus their use as surfactants is not very common.

Nonionic surfactants are compounds soluble in both acidic and alkaline media that do not undergo dissociation in aqueous solutions. As a rule, these compounds are the products of ethylene oxide addition to various substances with developed hydrocarbon chains, namely oxyethylenated primary and secondary fatty alcohols, $RO(CH_2CH_2O)_nH$, R(R')CHO

$(CH_2CH_2O)_nH$, polyethyleneglycol esters of fatty acids, $RCOO(CH_2CH_2O)_nH$, and oxyethylenated alkylphenols, $RC_6H_40\ (CH_2CH_2O)_nH$.

In all these compounds R is usually C_8 - C_9, and n is the average number of ethylene oxide segments. One can also obtain oxyethylenated derivatives of other compounds, such as sulfamides, phosphoric acid esters, etc.

Naturally occurring surfactants such as lipids are essential for applications in pharmacy and food products. Biosurfactants are produced by enzymatic reactions which can offer selectivity.

The solution properties of surfactants show abrupt change at a critical concentration that is consistent with the fact that above this concentration surfactant molecules or ions associate to form micelles. This concentration is defined as the **critical micelle concentration**, **CMC**, it's value depends on the structure of the surfactant molecule. At high concentrations, surfactant solutions form high-order assembly structures of the hexagonal, cubic, and lamellar phases.

Micellization causes the change of physical chemical properties of surfactant solution. Study the physical chemical properties of surfactant solutions allows to determine CMC value.

The adsorption of surfactants at the air/liquid and liquid/liquid interface can be measured using surface and interfacial tension measurements and application of the Gibbs adsorption isotherm. The adsorption of surfactants on solid surfaces depends on the nature of surfactant and substrate. The adsorption of ionic and nonionic surfactants on hydrophobic surfaces is determined by hydrophobic interaction between the alkyl chain and the surface. Ionic and nonionic surfactants interact with hydrophilic surfaces with the polar head groups. Various structures can be identified such semi-micelles, bilayers, etc.

Preparation of colloid systems. Colloid systems can be prepared by means of **dispersion** methods (e.g. by mechanical subdivision of larger particles or by dissolution in the case of lyophilic sols) or by **condensation** methods (from supersaturated solutions or supercooled vapours, or as the product of chemical reactions) or by a combination of these two (e.g. in an electrical discharge).

Peptization is a process of converting a precipitate into colloidal sol by shaking it with dispersion medium in the presence of small amount of electrolyte. For example:

$Fe(OH)_3$ Precipitates are converted into sol by shaking with small amount of $FeCl_3$ in suitable medium.

Purification of Colloidal Solutions

Purification of sols is done by the process of **dialysis**. The process is made faster by using electrode and is called **electrodialysis**. In this process, the removal of dissolved substance (electrolytes) from a collodial solution is done by means of diffusion through a semi-permeable membrane.

Some properties of colloidal solution.

1.**Tyndall Effect:** Scattering of light by the colloidal particles when a ray of light falls on it and the path of the light is illuminated. This phenomena shown by colloidal particles is termed as Tyndall Effect.

2.**Brownian Movement:** The Zig-Zag movement of colloidal particles (smaller the size, faster is the motion). It is due to unbalanced bombardment of the particles by the molecules of the dispersion medium. Particles do not settle and therefore sol is stable.

3. **Electrokinetic properties:** Due to preferential adsorption of ions from solution or formation of **electrical double layer**. The first layer of ions adsorbed on the surface of particles is dense adsorption layer and the ions of the opposite charge present in the sol forms a diffusion layer resulting in difference in potential between these layers. This potential difference is called as an **electrokinetic potential or zeta potential**.

Electrophoresis: When electric potential is applied across two Platinum electrodes dipped in colloidal solution, the colloidal particles will move towards the opposite electrode (i.e. negatively charged particles will move towards the positive electrode.)

Electroosmosis: Movenment of dispersion medium under the action of applied electric field.

4. **Coagulation and sedimentation:** A high free energy excess, particularly in systems with a fine degree of dispersion, is the cause of thermodynamic **instability**, which is the most important feature of a majority of disperse systems. Thermodynamic instability in turn entails various processes aimed at decreasing the surface energy, which results in the saturation of surface forces. Such processes may occur in a number of ways. For example, in a free disperse system partial saturation of the surface forces may take place in the contact zone between the particles when the latter approach each other closely, resulting in the formation of aggregates.

This phenomenon, referred to as **coagulation**, corresponds to the transition from a free disperse system to a structured one. A further decrease in the surface energy of disperse system may be caused by a decrease in the interfacial area due to the **coalescence** of drops and bubbles, or by fusion (sintering) of solid particles, as well as by the dissolution of more active smaller particles with the transfer of substance to less active larger particles.

The stability of a sol is due to the presence of charge on colloidal particles. But if this charge is somehow removed, the particles will come closer, aggregate and settle down. The process of settling of colloidal particles is called **sedimentation**.

Coagulation can be carried out by addition of electrolytes: The particles interact with the ions carrying charge opposite to that present on themselves resulting in coagulation. It has been observed that more the valence of the coagulating ion the greater its coagulation ability. It is known as **Hardy-Schulze rule**.

5. Changes in the structure and properties of dispersed structures occur as a result of coagulation, coalescence, and diffusional mass transfer. It is important to note that a dispersed system acquires qualitatively new **structural-mechanical (rheological) properties** as a result of particle coagulation and bridging, implying that the dispersed system is converted into a substance. Finally, coalescence can cause a dispersed system to disintegrate into its constituent macroscopic phases. Degradation of colloidal structures is a

desirable target in a variety of applications, such as churning butter or dehydrating and desalinating crude oil.

The study of physicochemical interactions at the interafaces opens up possibilities for directed regulation of surface phenomena and, accordingly, many chemical-technological, biological and other processes.

This educational handbook gathers multiple choice questions on colloid chemistry that could be applied for preparation to midterms, control works and exams.

Multiple choice questions cover all subjects of colloid chemistry and interfacial phenomena and there were prepared based on lectures on colloid chemistry.

The programme of the discipline "Colloid Chemistry"

1. Peculiarities of colloid systems. Colloidal state of substance.
2. Surface phenomena and great values of specific area.
3. Preparation of disperse systems, their purification and degradation.
4. Classification of disperse systems on the intensity of interfacial interactions, dispersion and aggregation of phases.
5. Characteristic features of lyophilic and lyophobic colloidal systems, the similarities and differences between them and the solutions and dispersions of high molecular compounds.
6. Optical properties of disperse systems.
7. Molecular-kinetic properties of disperse systems and solutions. Brownian motion, the theory of Brownian motion, Einstein-Smoluchowski.
8. Diffusion in colloidal systems. Fick's law. Einstein's equation. The dependence of the diffusion coefficient of the particle size.
9. Sedimentation of suspensions.
10. Determination of dispersed particle dispersion by sedimentation methods.
11. Optical properties of colloid systems. Rayleigh equation. Ultramicroscopy.
12. The basics of thermodynamics of surface phenomena.
13. Surface energy, surface tension, definition, units of measurements, methods of determinations.
14. Surface tension (specific free surface or interfacial energy) as a characteristic of surfaces.
15. The interfacial tension at the interface between two mutually saturated solutions of the limited solubility of liquids, Antonov rule.
16. Fundamentals of thermodynamics of surface phenomena.
17. The phenomenon of capillarity and wetting.
18. Thermodynamic conditions of wetting and spreading on solid and liquid surfaces. Contact wetting angle, the work of adhesion, quantitative wetting characteristics.
19. Selective wetting. Flotation of sulfides.
20. Gibbs equation.
21. Dependence of surface tension on the concentration of surfactant solution.
22. Surfactant classification. Application of surfactants, their classification by action mechanisms.
23. Adsorption at the gas – liquid interface. Gibbs equation.
24. Surface activity. Ducleaux- Traube rule.
25. Surfactants. Their classification.
26. Micellization of surfactant, CMC.
27. Langmuir monomolecular isotherm equation.
28. Adsorption work.
29. Thermodynamical foundation of Ducleaux-Traube rule.

30. Szyszkowski equation.
31. Adsorption at the gas – solid interface. Langmuir theory. BET and Polyany theories.
32. Molecular adsorption. Peculiarities of solution adsorption at solid surface.
33. Adsorption of electrolytes. DEL formation.
34. EDL theories. (Helmholtz, Gouy-Chapman, Stern theories).
35. Electrokinetic potential, factors effecting on it.
36. Electrokinetic phenomena. Electrophoresis. Electroosmosis. Application of them in various technologies.
37. Stability of disperse systems. Lyophobic and lyophilic systems.
38. Influence of different factors on stability.
39. Smoluchovski theory of rapid coagulation.
40. Slow coagulation. Stabilization factors.
41. DLVO theory of lyophobic systems. Theoretical foundation of Schultze-Hardy rule.
42. Stabilizers and destabilizers in some technological processes. Coagulation in nature.

1. Peculiarities, preparation and purification of disperse systems

1. Colloid Chemistry studies:

A. the physico-chemistry of disperse systems and surface phenomena
B. the physico-chemistry of surface phenomena
C. Chemistry of colloids
D. Physics of surface phenomena
E. all answers are incorrect

2. Calculate the specific area of gold particle with cube form, l = 1 µm

A. $6 \cdot 10^{-6} m^2$
B. $6 \cdot 10^{6}$ m^{-1}
C. 10^{6} m^{-1}
D. $6 \cdot 10^{-3}$ m^{-1}
E. 10^{-5} cm

3. Calculate the specific area of gold particle with spherical form, d = 1 µm

A. $6 \cdot 10^{-6} m^2$
B. 10^{6} m^{-1}
C. $6 \cdot 10^{6}$ m^{-1}
D. $6 \cdot 10^{-3}$ m^{-1}
E. 10^{-5} cm

4. Calculate the specific area of gold particle with spherical form, d = 10 nm

A. $6 \cdot 10^{-8} m^2$
B. 10^{-6} m^{-1}
C. $6 \cdot 10^{8}$ m^{-1}
D. $6 \cdot 10^{-3}$ m^{-1}
E. 10^{-5} cm

5. Suspensions are disperse systems of a ______type?

A. L/S
B. G/S
C. S/L
D. S/G
E. G/S

6. The main peculiarities of the colloidal state of a substance:

A. viscosity
B. dispersion
C. color
D. turbidity
E. all answers are incorrect

7. Highly dispersed systems include systems with particle sizes (r):

A. 10^{-3}-10^{-2} cm
B. 10^{-4}-10^{-3} cm
C. 10^{-6}-10^{-7} cm
D. 10^{-3} cm
E. 10^{-5} cm

8. Peculiarities of highly dispersed systems are:

A. total solubility of dispersed phase particles
B. high value of specific surface area
C. minimum free energy reserve of a system
D. stability of a system at constant temperature and pressure
E. additional data is required for a complete description

9. The specific surface area of particles containing in 1 kg of the dispersed phase has the dimension:

A. m^2/kg
B. m^{-1}
C. m
D. m^2/g
E. m^2/cm^3

10. Highly dispersed particles are visible:

A. visually
B. through optical microscope
C. through ultramicroscope
D. only using an electron microscope
E. all responses contain mistakes

11. The essential feature of a colloidal system is:

A. heterogeneity
B. stability
C. homogeneity
D. solubility
E. optical activity

12. The concentration of dispersed systems is:

A. concentration identifying the amount of solute in a solution
B. concentration identifying the number of particles in a dispersion medium
C. concentration identifying the number of dispersed particles per unit of volume
D. concentration identifying the number of particles of the dispersion medium and the dispersed phase
E. concentration identifying the volume fraction of dispersed phase particles per unit of volume

13. Disperse systems are classified according to the following general features:

A. by the aggregate state of the dispersed phase
B. by the aggregate state of the dispersion medium
C. by particle size
D. by aggregate state of dispersed phase and dispersion medium; particle size; the structure of dispersed phase
E. all responses contain a mistake

14. Call the type of disperse systems with particle sizes of 10^{-8}-10^{-9} m?

A. medium-dispersed systems
B. coarse-dispersed systems
C. molecular colloids
D. highly dispersed systems
E. all responses contain a mistake

15. What dispersed systems are characterized by Brownian motion?

A. medium-dispersed systems
B. hydrophobic systems
C. hydrophilic systems

D. highly dispersed systems
E. suspensions

16. The specific surface area (m^{-1}) of dispersed systems with spherical particles with a radius of $1 \cdot 10^{-5}$ cm is equal to:

A. 15 m^{-1}
B. 30 m^{-1}
C. 60 m^{-1}
D. 45 m^{-1}
E. 25 m^{-1}

17. What is the difference between sols and suspensions?

A. in the particle size of dispersed phase
B. in the nature of dispersion medium
C. in the nature of dispersed phase
D. in the intensity of interaction between adjacent phases
E. there are no differences

18. Hydrosols are systems in which

A. dispersion medium is alcohol
B. dispersion medium is water
C. dispersion medium is any organic solvent
D. dispersed phase is water
E. dispersed phase is a hydrocarbon

19. The emulsion is a

A. dispersed systems consisting of two liquid phases
B. dispersed systems in which only organic solvents are the dispersion medium
C. dispersed systems in which only water is dispersion medium
D. dispersed systems in which one of the phases is a gas
E. dispersed systems in which one of the phases is a solid

20. Direct emulsion is a disperse system in which

A. the dispersed phase is water, and the dispersion medium is organic solvents
B. the dispersed phase is organic solvents, and the dispersion medium is water
C. the dispersed phase is a surfactant, and the dispersion medium is water

D. the dispersed phase is a surfactant, and the dispersion medium is organic solvents
E. there is no correct answer

21.Reverse emulsion is a dispersed system in which

A. the dispersed phase is water and the dispersion medium is an organic solvents
B. the dispersed phase is organic solvents, and the dispersion medium is water
C. the dispersed phase is a surfactant, and the dispersion medium is water
D. the dispersed phase is a surfactant, and the dispersion medium is organic solvents
E. there is no correct answer

22.Foams are

A. dispersed systems in which the dispersed phase is a gas and the dispersion medium is a liquid
B. dispersed systems in which the dispersed phase is a liquid and the dispersion medium is a gas
C. dispersed systems consisting of two liquid phases
D. dispersed systems consisting of two liquid and solid phases
E. dispersed systems consisting of water and organic solvent

23.The sizes of colloidal particles vary in the range of (cm)?

A. 10^{-2} - 10^{-5}
B. 10^{-5} - 10^{-7}
C. 10^{-7} - 10^{-8}
D. 10^{-1} - 10^{-3}
E. there is no correct answer

24.What components can form an emulsion?

A. gaseous medium - liquid particles
B. liquid medium - solid particles
C. solid medium - gaseous particles
D. liquid medium - liquid particles
E. there is no correct answer

25.The method used for cleaning of disperse systems from excess of electrolyte is called as a:

A. electrolysis

B. electroosmosis
C. filtration
D. dialysis
E. chemical deposition

26.Dialysis is a method of disperse system cleaning from:

A. impurities of polymers
B. surfactant additives
C. highly dispersed fraction of dispersed phase particles
D. the presence of various electrolytes
E. there is no clear answer

27. **A _____ is a mixture where at least two substances with coarse-sized particles are combined together and stay together**

A. solution
B. suspension
C. colloid
D. particle mixture
E. there is no clear answer

28. **How would you differentiate a colloid mixture from a solution?**

A. the colloid's particles are larger
B. the colloid's particles are smaller
C. a colloid has a positive charge
D. a colloid has a negative charge
E. there is no clear answer

29. **What technique can be used to distinguish suspensions and colloids?**

A. by shaking
B. by heating the mixture to boiling
C. by freezing the mixture to a solid state
D.by leaving the mixture at room temperature and watching the separation
E. there is no clear answer

30. Indicate all methods of purification of disperse systems

A. electro-osmosis and dialysis

B. electrophoresis, electro-osmosis
C. electrolysis, filtration, settling potential method
D. dialysis, electrodialysis
E. all responses contain a mistake

31. The sulfur sol is obtained by mixing an alcoholic solution of sulfur with an excess amount of water. What is the name of this method?

A. method of solvent dislacement
B. physical condensation method
C. the method of the reaction of mutual exchange
D. the method of deposition
E. mutual dissolution method

32. Which of the following salts can be obtained by hydrolysis reaction

A. Ar_2S_3, AgI
B. PbS, AgCl
C. $Fe(OH)_3$, SiO_2
D. $Fe(OH)_3$, $Al(OH)_3$
E. $Al(OH)_3$, PbS

33. The most common method for obtaining AgI, AgCl sols is:

A. fractional deposition
B. hydrolysis reaction
C. oxidation-reduction reactions
D. ion exchange reaction
E. physical condensation

34. A positively charged $Fe(OH)_3$ sol can be obtained by following reactions:

A. complexations
B. recoveries
C. oxidations
D. hydrolysis
E. depositions

35. Organosols include dispersed systems with:

A. solid dispersion medium

B. the aqueous dispersion medium
C. organic dispersed phase
D. organic dispersion medium
E. liquid dispersed phase and dispersion medium

36. What type of dispersed systems are tobacco smoke, dust, fog, clouds related to?

A. hydrosols
B. emulsion
C. suspensions
D. aerosols
E. organosols

37. What type of dispersed systems are cast iron, steel, precious stones, alloys?

A. emulsions
B. suspensions
C. solid colloids
D. capillary systems
E. solid emulsions

38. Which of the following systems are direct emulsions?

A. natural oil
B. milk, butter
C. greases
D. cosmetic creams, mineral ointments
E. used motor oils

39. Which of the following systems are reverse emulsions?

A. crude oil
B. milk, butter
C. aqueous solutions of surfactants
D. glycerol solution in water
E. all answers are incorrect

40. What type of dispersed systems are oil, milk, some paints, varnishes?

A. suspension

B. emulsion
C. aerosols
D. solid-phase dispersed systems
E. gas emulsions

41. What type of dispersed systems are dust, smoke, fog, and clouds?

A. suspensions
B. emulsion
C. aerosols
D. lyosol
E. cryosol

42. Depending on the concentration of the dispersed phase, emulsions are divided into:

A. dilute, liquid
B. highly concentrated, solid
C. dilute, concentrated and highly concentrated
D. dilute with dense packing of dispersed phase particles
E. dilute, medium-concentrated

43. Molecular colloids include:
A. suspensions
B. solid colloidal systems
C. emulsions
D. polymer solutions
E. aerosols

44. Gold sol is obtained by the reaction: $2HAuCl_4 + 3H_2O_2 \rightarrow 2Au + 8HCl_4 + 3O_2$. What type of reaction is this?

A. double exchange reaction
B. hydrolysis reaction
C. precipitation reaction
D. fractional precipitation reaction
E. redox reaction

45. Preparation of dispersed systems by physical condensation is based on:

A. on the formation of a new phase in a supersaturated state of matter

B. on the formation of a new phase as a result of ion exchange reactions
C. on the formation of a new phase as a result of hydrolysis reactions
D. on the formation of a new phase as a result of reduction reactions
E. all answers contain errors

46. Hydrophobic systems are characterized by:

A. strong interaction of the dispersed phase with the dispersion medium
B. weak interaction of the dispersed phase with the dispersion medium
C. no interaction of the dispersed phase particles with each other
D. stability of the system
E. spontaneous formation of the system

47. What is called as partial concentration of a dispersed system?

A. mass concentration of the dispersed phase
B. volume concentration of the dispersed phase
C. number of particles of the dispersed phase per unit volume
D. molar ratio of the dispersed phase per unit volume
E. all responses contain errors

48. The unit of measurement of degree of dispersion (D) is:

A. m^2/g
B. m^2/kg
C. m^{-1}
D. cm^2/kg
E. kg/cm^2

49. Note the correct definition of a disperse system

A. disperse system is called a two-phase system
B. disperse system is a multiphase system
C. the disperse system is a two-phase system consisting of liquid and solid phases
D. disperse system is a system consisting of gaseous, liquid and solid phases
E. disperse system is a two – or multiphase, i.e. a heterogeneous system in which at least one of the phases is presented in a very small particles with a size superior to molecular size.

50. Which of the definitions of classification of dispersed systems by nature of interactions between particles of dispersed phase is correct?

A. liquid-phase
B. gaseous
C. solid
D. free-dispersed and structured
E. all answers are incorrect

51. What is the difference between lyophilic and lyophobic systems?

A. in lyophilic systems the particles of dispersed phase in comparison with lyophobic systems is well interacted with dispersion medium
B. lyophilic – is a liquid phase system, a lyophobic – is a solid phase system
C. the formation of lyophilic systems is accompanied by a positive heat effect and a lyophobic – no significant thermal effect
D. systems that are less stable than lyophobic systems
E. lyophilic system have a great supply of free interfacial energy

52. Who is considered as the founder of modern colloid chemistry?

A. Rehbinder P. A.
B. Mendeleev D. I.
C. Peskov N. P.
D. T. Graham
E. Langmuir

53. Who does the term "colloid" belong to?

A. F. Selmi
B. T. Graham
C. M. Faraday
D. J. Berzelius
E. A. Dumansky

54. The following statement is true in relation to colloidal solutions:

A. heterogeneous, unstable kinetically and thermodynamically, turbid
B. heterogeneous, relatively unstable kinetically, transparent, scattering light
C. heterogeneous, particles are visible under an optical microscope, turbid, scatter light
D. homogeneous, stable thermodynamically and kinetically, transparent

E. all answers are incorrect

55. A disperse system the symbol of which is a L/G is called:

A. suspension;
B. emulsion;
C. aerosol
D. sol
E. gel

56. **Disperse system, the symbol of which S/L is called:**

A. emulsion;
B. foam;
C. suspension;
D. aerosol
E. true solution

57. Lyophobic includes all dispersed systems in the series:

A. colloidal surfactant solutions, suspensions, foams, aerosols
B. sols, suspensions, emulsions, foams
C. suspensions, colloidal solutions of surfactants, foams, sols
D. emulsions, foams, colloidal solutions of surfactants, aerosols
E. emulsions, true solutions, colloidal solutions of surfactants, aerosols

58. All dispersed systems in the series are classified as free-dispersed:

A. suspensions, emulsions, foams, gels
B. foams, sols, emulsions, aerosols
C. sols, suspensions, emulsions, aerosols
D. gels, aerosols, foams, suspensions
E. emulsions, colloid solutions

59. To obtain colloidal systems from coarse dispersed systems, you can use the method:

A. electrophoresis
B. dialysis
C. dispersion
D. electroosmosis

E. all answers are wrong

60. For the formation of particles of colloidal size from true solutions, you can use:

A. mechanical dispersion
B. ultrasound;
C. physicochemical crushing of the sludge
D. hydrolysis reactions
E. shaking

61. Dispersion methods include:

A. fog formation
B. peptization
C. solvent exchange method
D. aggregation of atoms
E. all answers are incorrect

62.Specify the conditions for preparation of colloid systems

A. solubility of a dispersed phase substance in a dispersed medium
B. lack of a stabilizer
C. the molecular degree of dispersion of the particles of the dispersed phase
D. colloidal degree of dispersion of dispersed phase particles and heterogeneity of the dispersed phase and dispersion medium
E. all answers are incorrect

63. In what range do the sizes of colloidal particles change, cm?

A. $10^{-2} – 10^{-5}$
B. $10^{-5} – 10^{-7}$
C. $10^{-7} – 10^{-8}$
D. $10^{-1} – 10^{-3}$
E. all answers are incorrect

64. **Find the correspondences to the condensation method of obtaining colloidal systems:**

A. combination of atoms or molecules into aggregates
B. crushing of large particles of dispersed phase

C. shaking of system
D. heating of system
E. all answers are incorrect

65. Find the correspondences to the dispersion method of obtaining colloidal systems:

A. combination of atoms or molecules into aggregates
B. crushing of large particles of dispersed phase
C. settling of system
D. heatig of system
E. all answers are incorrect

66. **What filters can be used to separate colloidal particles?**

A. cellophane
B. paper
C. macrofilters
D. cloth filter
E. all answers are incorrect

67. **What methods are classified as condensation methods:**

A. solvent displacement method
B. peptization
C. homogenization
D. ultrasonic method
E. all answers are incorrect

68. **What methods are classified as condensation methods:**

A. crashing the powder
B. peptization
C. homogenization
D. redox reaction
E. all answers are incorrect

2. Molecular-kinetic and optical properties of dispersed systems

1. What are molecular-kinetic or "colligative properties"?

A. properties of solutions which are determined by the number of kinetic units (particles, molecules, atoms, ions, etc.) per unit of volume, not by composition of solution
B. properties characterized by size of dispersed phase
C. properties characterized by the property of the dispersion medium
D. properties indicating the interaction of solvent with the dissolved substance
E. properties dependent on the composition and nature of the solution

2. Why does Brownian motion occur in colloidal systems?

A. as a result of collision of the molecules of dispersion medium with dispersed phase particles
B. the result of chemical interaction between dispersion medium and dispersed particles
C. the result of convection currents
D. the result of physical interaction of dispersed phase with dispersion medium
E. no definite answer

3. How does the diffusion coefficient (D) depend on the temperature (T)?

A. D is inversely proportional to the temperature
B. D increases with increasing of temperature
C. the value of D with increasing T passes through the maximum
D. the value of D with increasing T passes through the minimum
E. D does not depend on

4. How does the diffusion coefficient (D) depend on the particle size (r)?

A. D increases with increasing r
B. D does not depend on r
C. D decreases with increase of r
D. D passes through a maximum with increasing r
E. D passes through a minimum with increasing r

5**. How does the diffusion coefficient (D) depend on the viscosity (η)?**

A. D increases with the increase of η
B. D decreases with the increase of η

C. D does not depend on η
D. D with growth of η passes through the maximum
E. D with growth of η passes through the minimum

6. Changing of which parameters of the disperse system reduces the intensity of Brownian motion?

A. increase in the temperature and viscosity of the fluid
B. decrease of fluid viscosity and radius of particles
C. increase in the temperature and radius of particles
D. reducing the radius of the particles, increasing the temperature
E. increase of viscosity, increase of particle radius and decrease in temperature

7. Changing of which parameters of the dispersed system increases the intensity of Brownian motion?

A. an increase in the temperature and viscosity of the fluid
B. reduction of fluid viscosity and particle radius, the temperature increase
C. increase of the temperature and radius of particles
D. reducing the radius of particles, temperature reduction
E. increase in viscosity, the particle radius and decrease in temperature

8. Where is the lower osmotic pressure: in true solutions or colloidal solutions? Why?

A. in true solutions is smaller, because they have smaller molecules and ions than colloidal particles
B. in true solutions is less, because they have less partial concentration than colloidal particles
C. in colloidal solutions is less, because they have greater partial concentration than true solutions
D. in colloidal solutions is less, because they have less partial concentration than true solutions
E. their osmotic pressure will be the same if both solutions are colorless and transparent

9. What phenomena are observed when light passes on colloid systems?

A. light scattering, reflection, refraction and interference
B. opalescence, reflection, scattering and absorption of light
C. reflection, interference and scattering
D. scattering, reflection, absorption and transmission of light through the system

E. scattering, concentration, refraction and diffraction of light

10. Light scattering in sols obeys the Rayleigh equation. Indicate the correct version of this equation

A. $I_{\mathbf{sc}} = I_0\, 24 \cdot \pi^3 v_n V^2 \left(\frac{n_1^2-n_2^2}{n_1^2+2n_2^2}\right)^2$

B. $J_{sc}=J_0 24\ \pi^3 V^2 \lambda$

C. $I_{\mathbf{sc}} = I_0 \frac{24 \cdot \pi^3 v_n V^2}{\lambda^4} \left(\frac{n_1^2-n_2^2}{n_1^2+2n_2^2}\right)^2$

D. $I_{\mathbf{sc}} = I_0 \frac{24 \cdot \pi^3 V^2}{\lambda^4} \left(\frac{n_1^2-n_2^2}{n_1^2+2n_2^2}\right)^2$

E. $I_{sc} = I_0 \frac{24 v_n \cdot V^2}{\lambda^4} \left(\frac{n_1^2-n_2^2}{n_1^2+2n_2^2}\right)^2$

11. How does the intensity of scattered light (J_{sc}) change with increasing of wavelength of the incident light (λ)?

A. $J_{\mathbf{sc}}$ does not change with growth of λ
B. $J_{\mathbf{sc}}$ decreases with increasing of λ
C. $J_{\mathbf{sc}}$ increases with growth of λ
D. $J_{\mathbf{sc}}$ passes through a maximum with increasing of λ
E. $J_{\mathbf{sc}}$ passes through the minimum with increasing of λ

12. What is the reason for the high intensity of scattered light by sols in comparison with high molecular compound (HMC) solutions (with the same parameters of the systems)?

A. large difference in the refractive indices of dispersed phase and dispersion medium for sols
B. smaller difference between the refractive indices of dispersed phase and dispersion medium for sols
C. large difference in the refractive indices of dispersed phase and dispersion medium for HMC solutions
D. high molecular weight
E. all answers are wrong

13. What is the difference between opalescence and fluorescence?

A. no difference

B. red filter in the light path extinguishes fluorescence and does not affect opalescence

C.blue filter in the light path quenches fluorescence and does not affect opalescence

D. light filters increase the wavelength of light in fluorescence and decrease it in opalescence

E. they can be distinguished using a microscope

14.The Rayleigh equation is applicable for what disperse systems?

A. applicable for systems with particle sizes not exceeding 0.7 times the incident wavelength

B. applicable for systems with spherical particles with a size of 40-50 microns

C. for systems with spherical particles of non-conducting electric current, the dimensions of which are less than the length of the incident light, located at some distance from each other

D. for systems having spherical particles of approximately the same size as the wavelength of the incident light

E. for any system having particles with a radius greater than the wavelength of the incident light

15. What optical methods are used for determination of size of colloid system particles?

A. turbidimetry, interferometry, refractometry

B. ultramicroscopy, photocolometry, nephelometry, turbidimetry

C. radiography, electronography

D. ultrascopy, refractometry, electronography, nephelometry

E. radiography, polarography, electrography, spectroturbidimetry

16. What methods are based on light scattering by sols?

A. photocolorimetry

B. spectrophotometry

C. electron microscopy

D. ultramicroscopy and nephelometry

E. turbidimetry and photocolorimetry

17.Using an ultramicroscope you can:

A. establish only the shape of the dispersed phase particles

B. establish a uniform distribution of particles of the dispersed phase in the dispersion medium

C. establish the state of aggregation of particles

D. establish the size and concentration of particles of the dispersed phase

E. set light absorption by sols

18. Using a nephelometer you can:

A. establish the shape of the dispersed phase particles

B. determine the concentration and size of particles of dispersed phase

C. determine the density of the particles of the dispersed phase

D. determine only the particle size of the dispersed system

E. determine the refractive index of a dispersed system

19. What are the differences between nephelometry and turbidimetry?

A. no different

B. nephelometry measures the optical density of systems, and turbidimetry measures the turbidity of systems

C. nephelometry is based on measuring the intensity of scattered light and turbidimetry is based on measuring the intensity of transmitted light

D. nephelometry is based on measuring the intensity of transmitted light and turbidimetry is based on measuring the intensity of scattered light

E. turbidimetry is based on measuring the optical density of the system and nephelometry is based on measuring the turbidity of the system

20. Absorption of light by molecular solutions obeys the law

A. Rayleigh's law

B. Lambert-Bouguer-Beer law

C. general laws

D. general laws showing the properties of solutions

E. there are no general laws of absorption, depending on different conditions, it is absorbed in different ways

21. What device can be used to observe the colloidal particles?

A. ultramicroscope

B. microscope

C. photocolorimeter

D. spectrophotometer
E. nephelometer

22. The cause of light scattering by colloidal particles is:

A. homogeneity of colloidal solutions;
B. the density of the dispersion medium;
C. the commensurability of the size of colloidal particles with the wavelength of light;
D. thermodynamic instability of colloids
E. all answers are incorrect

23. What properties can visually distinguish a colloidal solution from a coarse disperse system?

A. opalescence
B. refraction of light rays
C. sedimentation
D. adsorption on the surface of particles of electrolyte ions
E. all answers are incorrect

24. **Opalescence characterizes the______ properties of colloidal systems:**

A. molecular kinetic
B. electrokinetic
C. optical
D. surface
E. adsorption

25. Light scattering of colloidal particles is due to:

A. reflection of light from the surface of particles
B. by diffraction of light, i.e. bending around particles by light waves
C. absorption of light
D. absorption of light
E. all answers are incorrect

26. **Osmotic pressure of colloidal solutions depends on:**

A. the nature of the particles
B. particle size

C. the number of particles per unit of volume
D. the composition of solution
E. all answers are incorrect

27.**What properties are typical for colloid systems**:

A. sedimentation
B. opalescence
C. reflection of light rays
D. precipitation
E. coalescence

28.What phenomena are accompanied by osmosis?

A. reducing the concentration of the solution
B. pressure build-up
C. temperature rise
D. improving solubility
E. increasing the concentration of the solution

29. **To increase the rate of diffusion it is necessary to:**

A. reduce the concentration difference in the two layers
B. increase temperature
C. Reduce pressure
D. Place the membrane between the layers
E. all answers are incorrect

30. Indicate the properties of high molecular weight compound solutions that establish their similarity with colloidal systems

A. the size of macromolecules
B. homogeneity
C. high diffusion rate
D. low degree of stability
E. ability to pass through a semipermeable membrane

3. Surface phenomena and surface layers, adsorption

1. Surface phenomena are spontaneous processes occurring:

A. at the gas - gas interface
C. at the interface
B. in homogeneous systems
D. in liquids
E. all answers contain mistakes

2. **The following statement is true for the surface layer**:

A. contains a large number of molecules
B. has a low viscosity
C. does not differ in properties from the inner layers of the liquid
D. has excess free surface energy
E. all answers contain mistakes

3. **Surface phenomena are spontaneous processes:**

A. at the gas - gas interface
B. in homogeneous systems
C. at the interface
D. in liquids
E. all answers are incorrect

4. Free surface energy is a quantity equal to:

A. $G_S = \sigma \cdot S$
B. $G_S = \sigma + S$
C. $G_S = \sigma / S$
D. $G_S = S / \sigma$
E. $G_S = \sigma \cdot D$

5. With a decrease of surface area, the free surface energy:

A. increases
B. decreases
C. does not change
D. reaches its maximum value
E. all answers are incorrect

6. **For surface tension the following statement is not true:**

A. characterizes the excess of surface energy per 1m^2 of the interface
B. is equal to thermodynamically reversible, isothermal work that must be done to increase the interfacial area by one;
C. has a dimension of J/m^2;
D. is equal to thermodynamically reversible, isothermal work that must be done to reduce the interfacial area by one
E. all answers are incorrect

7. Surface activity is the ability of

A. the solvent to increase the surface tension of the solution;
B. the solute to change the surface tension of the solvent;
C. the solvent to change the surface tension of the solution;
D. the solvent to lower the surface tension of the solution
E. all answers are incorrect

8. Surfactants are substances that

increase the surface tension of the solvent
do not change the surface tension of the solvent
lower the surface tension of the solvent
reduce the viscosity of the solvent
all answers are correct

9. Surfactants are substances with surface activity (g):

A. $g > 0$
B. $g < 0$
C. $g = 0$;
D. $g = 1$
E. all answers are correct

10. Surface inactive substances are substances with surface activity (g):

A. $g > 0$
B. $g < 0$
C. $g = 0$;
D. $g = 1$
E. all answers are correct

11. Surfactants include all substances in the group:

A. methanol, sucrose, propionic acid
B. ethanol, ethanal, butyric acid
C. ethanol, ethanic acid, glycerin
D. butanol, glycerin, sucrose
E. all answers are correct

12. Surface-inactive substances are substances

A. increasing the surface tension of the solvent;
B. reducing the surface tension of the solvent:
C. practically do not change the surface tension of the solvent;
D. reducing the surface tension of the solution
E. all answers are incorrect

13. The dependence of the surface activity of substances in the homologous series reflects by the rule of:

A. Szyszkowski
B. Schulze-Hardy;
C. Van't Hoff;
D. Duclaux- raube
E. Langmuir

14. With an increase of the hydrocarbon chain by -CH_2 group, the surface activity:

A. decreases by 3–3.5 times
C. does not change
B. increases by 3–3.5 times
D. decreases by 2 times
E. decreases by 5 times

15. **The greatest surface tension is characteristic for:**

A. propanol
B. water
C. butanol
D. methanol
E. pentanol

16. Lowering the surface tension of water will be observed at the addition of :

A. glycerin;
B. ethanal;
C. sulfuric acid;
D. sucrose
E. sodium chloride

17. **The dependence of surface tension on surfactant concentration reflects the equation:**

A. Freundlich
B. Szyszkowski
C. Nernst
D. Langmuir
E. Rehbinder

18. **Surface activity increases in the following order:**

A. methanol, ethanol; propanol, butanol
B. methanal, ethanal, propanal, butanal
C. ethanoic acid, methanoic acid, butanoic acid
D. propanal, butanal, ethanal, pentanal
E. ethanoic acid, methanoic acid, methanal, ethanal

19. Mathematical expression of the Szyszkowski equation:

A. $\sigma = \sigma_o - B\ (1 + KC)$
B. $\sigma = \sigma_o - B \ln (1 + KC)$
C. $\sigma = \sigma_o - B \cdot \ln (1 + C)$
D. $\sigma = \sigma_o - B \ln (1 + K)$
E. $\sigma = \sigma_o + B\ (1 + K)$

20. For the concept of adsorption the following statement is true:

A. it is the absorption of a substance on the surface of a solid
B. is the absorption of the substance by the entire volume of the solid
C. it is process does not occur spontaneously
D. it is a purely physical process
E. all answers are incorrect

21. The reverse process to adsorption is called as:

A. condensation
B. absorption
C. wetting
D. desorption
E. flotation

22. The state of adsorption equilibrium is characterized by:

A. minimum adsorption rate
B. maximum adsorption rate
C. equality of the rates of adsorption and desorption
D. equality of the rates of absorption and adsorption
E. all answers are incorrect

22. The adsorption isotherm reflects the dependence of the amount of adsorbed substance on:

A. temperature
B. the surface area of the adsorbent
C. the concentration of the solute
D. solvent concentration
E. pressure

23. Chemical adsorption is:

A. a chemical processes in the volume of the adsorbent
B. a chemical interaction of the adsorbent with the adsorbate
C. the accumulation of the adsorbent on the surface of the adsorbate
D. an increase of the substance concentration at the interface
E. all answers are incorrect

24. The following statement is true for the concept of chemisorption:

A. is caused by the forces of intermolecular interaction
B. does not require activation energy
C. runs at a measurable speed at a relatively high temperature and is characterized by an activation energy
D. the adsorbed molecule and adsorbent can be considered as two independent systems
E. all answers are incorrect

25. With increasing temperature the physical adsorption:

A. does not change
B. decreases
C. increases
D. reaches its maximum value
E. reaches its maximum value

26. The following statement is incorrect for adsorption at the liquid-gas interface:

A. the surface of the liquid is equivalent for adsorption
B. molecules of the adsorptive can freely move along the surface of liquid under the influence of thermal motion
C. adsorptive molecules are rigidly bound to any one area of the surface
D. the force field of the gas phase can be neglected
E. all answers are incorrect

27. The Langmuir isotherm equation has the following mathematical expression:

A. $\Gamma = \Gamma_{\infty}KP / (1 + KP)$
B. $\Gamma = KP / (1 + KP)$
C. $\Gamma = \Gamma_{\infty}K / (1 + KP)$
D. $\Gamma = \Gamma_{\infty}P / (1 + KP)$
E. $\Gamma = \Gamma_{\infty}KP / (1 + P)$

28. For adsorption at the "solid - gas" interface the following statement is true:

A. occurs on any part of a hard surface
B. is always kinetically irreversible
C. accompanied by capillary condensation on solid adsorbents
D. is not accompanied by absorption processes
E. all answers are incorrect

29. The mathematical notation of the Freundlich equation is as follows:

A. $\Gamma = K + C^{1/n}$
B. $\Gamma = K \cdot C^{1/n}$
C. $\Gamma = K \cdot C \cdot n$
D. $\Gamma = K + C^{n}$

E. $\Gamma = K + nC$

30. Wetting is a spontaneous physicochemical process:

A. increasing of the area of contact of the gas with the solid surface
B. increasing of the area of contact of the liquid with the solid surface
C. increasing of free surface energy
D. increasing of surface tension
E. decreasing of surface tension

31. The relationship between the wetting angle and surface tension expresses the equation:

A. Gibbs
B. Duclaux-Traube
C. Young
D. Van't Hoff
E. Dupre

32. For molecular adsorption from a solution the following statement is true:

A. solvent molecules do not compete with solute molecules for active centers of the sorbent
B. there is no interaction between the surface of an adsorbent and solvent
C. the worse the solvent is adsorbed, the better the solute is adsorbed
D. the solvent is adsorbed better if its surface tension is higher
E. adsorption does not dependent on nature of solvent

33. Rebinder's rule says that the greater the initial polarity difference:

A. the process of adsorption is stronger in the direction of equalizing the phase polarities
B. the adsorption process proceeds more slowly towards the equalization of the phase polarities
C. the adsorption process is slower towards an increase in the phase polarity difference
D. the adsorption process is stronger towards an increase in the phase polarity difference
E. adsorption does not occur

34. Give the correct definition of surface tension:

A. is the force of attraction of molecules (ions) located in 1 cm^3 of the system

B. is the repulsive force of molecules per unit surface area
C. is the work of formation of a unit of new surface
D. is the work of transferring 1 mole of a substance from one phase to another
E. all answers contain mistakes

35. How is surface tension measured?

A. in mol/cm^2
B. in mol/cm^3
C. in erg/ml
D. in N/ml
E. in J/m^2

36. How does the surface tension depend on the nature of the substance?

A. with an increase in the polarity of molecules (ions) of a substance, it increases
B. with an increase in the polarity of molecules (ions) of a substance, it decreases
C. with increasing polarity of the substance passes through a maximum
D. with increasing polarity of the substance passes through a minimum
E. the nature of the substance has no effect

37. Which of the following substances has the highest surface tension?

A. C_6H_{14}
B. H_2O
C. C_2H_5OH
D. CH_3COOH
E. $C_6H_5NO_2$

38. What effect does temperature T have on σ?

A. with increasing T, σ increases
B. with an increase in T, σ decreases
C. with increasing T, σ first grows and then falls
D. T has no effect on σ
E. T affects σ only up to a certain T

39. What is the main difference between the surface tension of crystals (σ_c) from the surface tension of liquids (σ_l)?

A. $\sigma_c>\sigma_l$

B. $\sigma_c < \sigma_l$
C. σ_c has different meanings on different planes of crystal cleavage
D. σ_c cannot be determined by methods for determining σ_l
E. as the teperature rises, σ_c grows, and σ_l decreases

40. Which of the following relationships is correct?
(σ_c - surface tension of the crystal; σ_a - surface tension of an amorphous body; σ_l - surface tension of a liquid)

A. $\sigma_c > \sigma_a > \sigma_l$
B. $\sigma_c < \sigma_a > \sigma_l$
C. $\sigma_c < \sigma_a < \sigma_l$
D. $\sigma_c > \sigma_a < \sigma_l$
E. depends on the nature of the crystal, amorphous body and liquid

41. What is the measure of the heterogeneity of the system?

A. different molecular weight
B. different polarity of contacting phases
C. the difference in the dipole moments of the molecules of the contacting phases
D. the presence of an interface
E. there is no definite answer

42. What is the measure of dispersion?

A. surface tension
B. sedimentation rate of particles
C. intensity of interaction of the dispersed phase with the dispersion medium
D. value which is inverse to the linear particle size
E. intensity of Brownian motion

43. What is called as an adsorption?

A. adsorption is a change in the concentration of a substance at the interfaces
B. adsorption is the binding of molecules and ions by the volume of the condensed phase
C. adsorption is the absorption of a substance by the volume of a solid adsorbent
D. adsorption is the ratio of the concentration of a substance in the bulk and the surface layer
E. adsorption is the binding of gases and vapors per unit of time

44. Is it possible to determine the length of the surfactant based on the results of adsorption?

A. yes, if the adsorption rate is known
B. yes, if the time to establish adsorption equilibrium is known
C. yes, if the specific surface area of the adsorbent is known
D. yes, if the mass of the adsorbent is known
E. yes, if the maximal adsorption (A∞) and the density of the adsorptive in liquid form are known

45. Is it possible to determine the area occupied by a surfactant molecule in the adsorption layer?

A. it is possible if the limiting adsorption is known (A∞)
B. it is possible if the length of the adsorptive molecule is known
C. it is possible if the density of the adsorptive is known
D. is possible if the polarizability of the adsorptive molecules is known
E. is possible if the density of the adsorbent is known

46. What is the ratio between the capillary pressure of mercury and water? (droplet diameters are the same)

A. $\Delta P_{Hg} \rangle \Delta H_2O$ B. $\Delta P_{Hg} \langle \Delta H_2O$
C. $\Delta P_{Hg} = \Delta H_2O$
D. $\Delta P_{Hg} = 0{,}6\Delta H_2O$
E. $\Delta P_{Hg} = 0{,}1\Delta H_2O$

47. Indicate which of the following equations is the fundamental adsorption equation at the liquid/gas interface:

A. $\Gamma = -\frac{c}{RT} \cdot \frac{d\sigma}{dc}$
B. $\Gamma = -\frac{a}{RT} \cdot \frac{d\sigma}{dc}$
C. $\Gamma = -\frac{1}{dc} \cdot \frac{d\sigma}{RT}$
D. $\Gamma = -\frac{a}{da} \cdot \frac{d\sigma}{RT}$

E. $\Gamma = -\frac{a}{RT} \cdot \frac{1}{da}$

48. What is capillary pressure?

A. this is the pressure at the ends of the capillaries
B. this is the pressure above a flat surface
C. this is the pressure inside the molecular fluid
D. this is the pressure above the surface of the capillary
E. this is the difference in pressure over curved and flat surfaces

49. Find the general Laplace equation for capillary pressure:
(where σ is the surface tension of the liquid)

A. $\Delta P = \frac{2\sigma}{R}$
B. $\Delta P = \frac{\sigma}{R}$
C. $\Delta P = \sigma \cdot R$
D. $\Delta P = \frac{R}{\sigma}$
E. $\Delta P = \frac{R}{2\sigma}$

Γ=-C/RT\left(dσ/dc\right)

50. How to turn a hydrophilic surface into a hydrophobic one?

A. heat treatment
B. surface treatment by electric field
C. surface treatment with aerosols
D. application of a monomolecular layer of aqueous solutions
E. application of a monomolecular surfactant layer from an aqueous medium

51. What is the effect of the wettability of the walls of the capillary with a liquid on its rise in it?

A. the better the liquid wets the walls of the capillary, the higher the rise in it
B. the better the liquid wets the capillary wall, the worse it rises
C. the wettability of the capillary walls by this liquid does not affect its rise
D. When wetted with liquid, the liquid level drops
E. there is no definite answer

52. Which of the following equations is the Jurin equation?

A. $H = \frac{P\sigma}{\rho_0 g}$

B. $H = \frac{2\sigma_{жг} \cos\theta}{r_0(\rho - \rho_0)g}$

C. $H = \frac{2\sigma_{жг} \cdot \sigma_{тж}}{r_0(\rho - \rho_0)g}$

D. $H = \frac{2(\sigma_{жг} - \sigma_{тж})}{r_0(\rho - \rho_0)g}$

E. $H = \frac{2(\sigma_{тг} - \sigma_{тж})}{r_0(\rho - \rho_0)g}$

53. Forces of cohesion are

A. forces of attraction between molecules of the same phase
B. adhesion forces between molecules of different phases
C. forces acting at the interface
D. forces acting between particles of the dispersed phase and the dispersion medium
E. repulsive forces between molecules of the same phase

54. Forces of adhesion are

A. adhesion forces between molecules of the same phase
B. adhesion forces between molecules of different phases
C. forces of repulsion between particles of the dispersed phase and the dispersion medium
D. forces acting inside particles
E. repulsive forces between molecules of the same phase

55. What is the reason for the improvement in the wetting of hydrophobic surfaces with the introduction of surfactants?

A. formation of a monomolecular surfactant layer with polar groups facing the solid surface
B. formation of a monomolecular surfactant layer with hydrophobic groups facing the surface of a solid
C. increase in the surface tension of the liquid (σ_{lg})

D. adsorption of surfactant micelles on the solid surface
E. the formation of a saturated monomolecular surfactant layer on the surface of a solid with hydrophilic groups facing this surface and an increase in (σ_{lg})

56. Which of the following substances is better adsorbed at the water/benzene interface?

A. sucrose
B. ethylene glycol
C. oleic acid
D. formic acid
E. butyl alcohol

57. In which of the following capillaries does the water rise higher?

A. glass capillary with a diameter of 1 mm
B. the same capillary, but pre-treated with paraffin solution and dried
C. glass capillary with a diameter of 0.1 mm
D. teflon capillary
E. glass capillary with a diameter of 0.5 mm

58. What is the relationship between the works of adhesion (W_a), cohesion (W_c) and contact angle (Θ)?

A. $Wa = 2Wk + \cos\theta$
B. $Wa = Wk - \cos\theta$
C. $\cos\theta = \frac{Wa - 0{,}5Wk}{0{,}5Wk}$
D. $\cos\theta = Wa / Wk$
E. $\cos\theta = Wa / \cos\theta$

59. How can you change the wettability of a solid surface?

A. by heat treatment
B. by freezing
C. adsorption of surfactants
D. irradiation
E. treatment with deionized water

60. Flotation separation of minerals based on?

A. on the difference in particle size of gangue and minerals
B. on the difference in water wettability of gangue particles and minerals
C. on the difference in density of waste rock particles and minerals
D. on the difference in water solubility of gangue particles and minerals
E. there is no definite answer

61. What is the reason for the spherical shape of drops in zero gravity?

A. decrease in surface tension
B. adhesion of a droplet to a solid surface
C. the absence of the Earth's gravitational field, which distorts the shape of the drop
D. by cosmic rays
E. no magnetic field

62. The ratio of surface tension (σ) and surface pressure (π) is expressed as:

A. $\sigma = \pi$
B. $\sigma > \pi$
C. $\sigma < \pi$
D. $\pi = \sigma_0 - \sigma$ (where σ is the surface tension of the liquid, σ_0 is the surface tension of the solvent)
E. $\pi = \sigma_0 + \sigma$

63. How does the surface charge affect the surface tension of solids?

A. increases σ
B. lowers σ
C. does not affect
D. positive charge increases σ and negative charge decreases
E. negative charge increases σ and positive does not affect

64. Flotation based on?

A. on the difference in the density of particles of ore and waste rock
B. on different wettability of ore particles and waste rock
C. on the difference in particle size of ore and waste rock
D. on the appearance of repulsive forces between particles of ore and waste rock
E. on the difference between the electric charge of ore particles and waste rock

65. Hydrophilic adsorbents include:

A. activated carbon
B. graphite
C. talc
D. clay
E. oily surface

66. The distribution of the absorbed substance in the entire volume of the absorber is called as:

A. adsorption
B. absorption
C. chemisorption
D. capillary condensation
E. opalescence

67. Find the hydrophobic adsorbent:

A. activated carbon
B. capillary glass
C. zeolite
D. silica gel
E. clay

68. Surfactant was added to the solution. The surface tension in this case

A. decreased
B. increased
C. has not changed
D. increased and then decreased
E. decreased and then increased

69. How the area per surfactant molecule is determined in a saturated adsorption layer?

A. $S_0 = \frac{6}{a}$
B. $S = \frac{1}{\Gamma_\infty N_A}$
C. $S_0 = \frac{M}{N_a} \cdot \Gamma_\infty$

D. $S_0 = M \cdot N_a \cdot \Gamma_\infty$

E. $S_0 = N_a \cdot \Gamma_\infty$

70. What equation is used to calculate the adsorption at the liquid/gas interface using the surface tension isotherm?

A. Langmuir equation
B. Gibbs equation
C. Szyszkowski equation
D. BET equation
E. Young's equation

71. What is the surface activity of surfactants?

A. $G = -\frac{d\sigma}{dc}$

B. $G = -\frac{c}{d\sigma}$

C. $G = \lim\limits_{c \to 0} \frac{d\sigma}{dc}$

D. $G = -\frac{\Delta\sigma}{\Delta c} \cdot \Gamma$

E. $G = -\frac{W_{n+1}}{W_n}$

72. What is the thickness of the surfactant adsorption layers?

A. $\delta = \frac{\Gamma_\infty \cdot M}{d}$

B. $\frac{\Gamma_\infty}{dM}$

C. $\frac{dM}{\Gamma_\infty}$

D. $\frac{M}{\Gamma_\infty d}$

E. $\Gamma_\infty \cdot M \cdot d$

73. How does the surface activity of surfactant molecules change in the

homologous series with an increase in the length of a hydrocarbon radical per methylene group, and what rule does this pattern obey?

A. 3.5 times; Bancroft rule
B.3- 3.5 times; Duclaux-Traube rule
C. 2.5 times; Traube-Duclaux rule
D. 3.2 times; Rebinder rule
E. 3.5 times; Peskov's rule

74. Surfactants include substances with the following characteristics:

A. the structure is diphilic, the ability to reduce the surface tension of water
B. the structure is hydrophilic
C. lipophilic structure
D. amphiphilic structure, increases the surface tension of water
E. the structure is diphilic, does not change the surface tension of water

75. Determine the type of surfactant - $C_{17}H_{33}COONa$

A. cationic
B. anionic
C. amphoteric
D. micellar
E. nonionic

76. Determine the type of surfactant - cetyltrimethyl bromide

A. cationic
B. anionic
C. amphoteric
D. nonionic
E. all answers are wrong

77. The equation of the two-dimensional state of surfactant in surface layers:

A. $\pi = cRT$
B. $\sigma_0 - \sigma = \pi A$
C. $\pi A = RT$
D. $P_0 V = RT$
E. $\pi A = 2RT$

78. What rule determines the adsorption of substances at the solid-solution interface?

A. Traube-Duclaux Rule;
B. equalizing the polarities of the contacting phases according to Rebinder;
C. micelle formation according to Peskov-Fayans;
D. surface action;
E. Langmuir-Blodgett

79. The Rehbinder effect is:

A. adsorption reduction in the strength of solids
B. adsorption increase in the strength of solids
C. stabilization of dispersed systems with surfactants
D. structuring of a dispersed system
E. destruction of coagulation structures

80. What equation allows you to estimate the specific surface of the adsorbent?

A. $S_{уд} = S_0 \Gamma_\infty N_a$
B. $S_{уд} = \frac{\Gamma_\infty \cdot M}{N_a}$
C. $S_{уд} = \Gamma_\infty MN_a$
D. $S_{уд} = N_a \Gamma_\infty /d$
E. there are inaccuracies in all the answers

81. Which of the substances has the highest surface activity?

A. $C_{10}H_{21}OH$
B. C_3H_7OH
C. $C_{17}H_{35}OH$
D. C_4H_9OH
E. CH_3OH

82. Which of the substances has the highest surface activity?

A. CH_3COOH
B. $C_8H_{17}COOH$
C. $C_7H_{15}COOH$
D. $C_5H_{11}COOH$

E. C_4H_9COOH

83. Which of the following adsorbents is well wetted by a polar liquid?

A. paraffin
B. graphite
C. sulfur
D. cellulose
E. coal

84. Which of the adsorbents is hydrophobic if its wetting angle (θ) formed by water in air is known?

A. graphite (θ = 60 °)
B. talc (θ = 69 °)
C. sulfur (θ = 78 °)
D. paraffin wax (θ-106 °)
E. quartz (θ = 0 °)

85. What is the characteristic of chemisorption?

A. low specificity
B. reversibility
C. low value of heat of absorption (Q = 8-20 kJ / mol)
D. high value of heat of absorption (Q = 80-800 kJ / mol)
E. Van der Waals forces of interaction between adsorbate and adsorbent

86. Purification of water from oil impurities using adsorption on:

A. Al_2O_3;
B. NaCl;
C. activated carbon;
D. clay;
E. anionite.

87. Langmuir adsorption isotherm equation:

A. $\Gamma = \Gamma_{\infty}\frac{C}{C + K}$

B. $\Gamma_{\infty} = \Gamma \frac{C}{C + K}$

C. $\Gamma = \Gamma_{\infty} \frac{C + K}{C}$

D. $\Gamma = \Gamma_{\infty} \frac{K}{C + K}$

E. $\Gamma = \Gamma_{\infty} \frac{KC}{KC + 1}$

88. What is the main characteristic of ion exchangers?

A. the presence of counterions in the solution
B. small specific surface area of the adsorbent
C. exchange capacity and ion exchange constant
D. the minimum exchange capacity of the adsorbent
E. all answers are incorrect

89. Find the capacity of a monolayer Γ_{∞} if the maximal value of the area occupied by the surfactant molecule on the surface is known A_0 = 0.20 nm2

A. 8.3.·10^{-6} mol / m^2;
B. 3.8·10^{-6} mol / m^2;
C. 4.3·10-6 mol / m^2;
D. 5.0·10^{-6} mol / m^2;
E. 1.0·10^{-6} mol / m^2.

90. The essence of ion-exchange adsorption is:

A. equivalent exchange of counterions with a solution
B. excessive absorption of ions
C. equivalent exchange of potential-determining ions
D. displacement of potential-determining ions by counterions
E. there is no correct answer

91. In the rows of cations below indicate the row that correctly reflects the adsorption capacity of cations.

A. $Al^{3+}>Ba^{2+}>Ca^{2+}>K^{+}>Na^{+}$
B. $Ba^{2+}> Al^{3+} >Ca^{2+}>K^{+}$
C. $Ca^{2+} > K^{+}> Li^{+}> Al^{3+}$
D. $Al^{3+}> K^{+}>Ca^{2+}$
E. $K^{+} > Al^{3+} > Ba^{2+}$

92. Which series reflects the correct dependence of the adsorption capacity of ions on their radius?

A. $Li^{+}>Cs^{+}>Rb^{+}>K^{+}>Na^{+}$;
B. $Li^{+}>Na^{+}>K^{+}>Rb^{+}>Cs^{+}$;
C. $Cs^{+} > Rb^{+} >K^{+}> Na^{+} > Li^{+}$;
D. $Na^{+} > Rb^{+}> Li^{+} > Cs^{+} > K^{+}$;
E. $Rb^{+} > Cs^{+} > Li^{+} > K^{+}> Na^{+}$.

93. The equation of ion exchange is written in the following form:

A. $x_1^{1/Z1} = K_1 \frac{a_1^{1/Z1}}{a_2^{1/Z2}}$

B. $x_1^{1/Z1} / x_2^{1/Z2} = K_1 \frac{a_1^{1/Z1}}{a_2^{1/Z2}}$

C. $x_2^{1/Z2} = K_1 a_1^{1/Z1}$

D. $x_1^{1/Z1} = K_1 a_1^{1/Z1}$

E. $\frac{x_1^{1/Z1}}{x_2^{1/Z2}} = K_1 a_1^{1/Z1}$,

where X is the number of absorbed ions, and a is the activity of ions in the solution.

94. Which of the following forms of the adsorbent belongs to the anionite?

A. $RSO_3^{-}H^{+}$;
B. $RCOO^{-}H^{+}$;
C. $RNH_4^{+}OH^{-}$;
D. $RPO_4^{-}H^{+}$;
E. $RSiO^{-}H^{+}$.

95. For which ion exchangers listed below will adsorption of H^+ ions be maximum?

A. strongly acidic cation exchangers
B. strongly basic anion exchangers
C. weakly basic anion exchangers
D. soils, grounds, protein substances
E. charcoal, teflon powder, soot

96. For which of the below mentioned ion exchangers will OH^- adsorption be maximum?

A. strongly acidic cation exchangers
B. strongly basic anion exchangers
C. weakly basic anion exchangers
D. soils, grounds, protein substances
E. charcoal, teflon powder, soot

97. For what adsorbents is the Traube-Duclaux rule inverted?

A. non-porous;
B. large pore;
C. finely porous;
D. medium-porous;
E. all answers are incorrect

98. Calculate S_{sp} - specific surface of the adsorbent, if the value of the maximal adsorption is $\Gamma = 37 \cdot 9.10^{-2}$ mol / kg, and the landing area $S_0 = 16 \cdot 10^{-20}$ m^2 and $N_A = 6.02 \cdot 10^{23}$

A. $36.51 \cdot 10^3$ m^2 / kg;
B. $3.65 \cdot 10^3$ m^2 / kg;
C. $0.36 \cdot 10^3$ m^2 / kg;
D. $73.02 \cdot 10^3$ m^2 / kg;
E. $89.05 \cdot 10^3$ m^2 / kg;

99. What does the inflection point on the Langmuir adsorption isotherm show?
A. establishment of adsorption equilibrium
B. formation of a polymolecular adsorption layer
C. start of desorption of molecules
D. formation of a monomolecular adsorption layer
E. there is no definite answer

100. Which of the options meets the requirements for surfactants?

A. $\frac{d\delta}{dc}\langle 0$ $\Gamma>0$

B. $\frac{d\delta}{dc}\rangle 0$ $\Gamma<0$

C. $\frac{d\delta}{dc}=0$ $\Gamma=0$

D. $\frac{d\delta}{dc}\to\infty$ $\Gamma\to 0$

E. $\frac{dc}{d\delta}\langle 0$ $\Gamma<0$

101. Langmuir adsorption isotherm equation in linear form for finding the constants:

A. $\frac{\Gamma}{C}=\frac{A}{\Gamma_\infty}+\frac{C}{\Gamma}$

B. $\frac{C}{\Gamma}=\frac{1}{\Gamma_\infty A}+\frac{C}{\Gamma_\infty}$

C. $\frac{C}{\Gamma}=\frac{\Gamma_\infty}{A}+\frac{C}{\Gamma}$

D. $\frac{C}{\Gamma}=\frac{A}{\Gamma_\infty}+\frac{\Gamma}{C}$

E. $\frac{C}{\Gamma}=\frac{\Gamma_\infty}{A}+\frac{\Gamma}{C}$

4. Lyophilic systems

1. The critical micellization concentration of surfactant decreases:

A. with decreasing polarity of the medium
B. with a decrease in the length of the hydrocarbon radical
C. with increasing pH of the medium
D. with an increase in the length of the hydrocarbon radical
E. with an increase in the degree of dissociation of polar groups

2. The driving force of micelle formation in aqueous surfactant solutions are:

A. electrostatic interaction between potential-determining ions and counterions
B. change in the thickness of the EDL on the micelle surface
C. hydrophobic interactions between hydrocarbon radicals
D. electrostatic repulsion of like charged polar groups
E. change in ξ-potential

3. The formation of micelles in surfactant solutions is accompanied by:

A. by decreasing of ΔU
B. decrease of ΔG and increase of ΔS
C. streamlining the structure of water
D. rise of σ at the interface with water
E. increasing of ΔH

4. Which of the following processes is called as a solubilization?

A. dissolution of dye molecules in reverse micelles
B. dissolution of surfactant molecules in dyes
C. dissolution of water-insoluble organic molecules in surfactant micelles
D. dissolution of surfactants in colloidal micelles
E. aggregation of nonionic surfactant molecules

5. In what medium are the reverse micelles of cationic surfactant - cetylpyridinium chloride - formed?

A. 1M NaCl
B. $6\cdot10^{-4}$ mol / L NaCl
C. C_2H_5OH
D. benzene

E. Sudan III

6. HLB is a value showing:

A. the ratio between polar and non-polar surfactant parts
B. solubility of surfactants in water
C. the number of ionic groups in the surfactant molecule
D. length of surfactant hydrocarbon radical
E. micelle-forming ability of surfactants

7. In which of the following media the sodium oleate micelle is formed?

A. CH_4
B. C_6H_6
C. H_2O
D. C_4H_9OH
E .$CHCl_3$

8. Which of this surfactant forms the most stable micelle?

A. $C_{17}H_{33}COONa$
B. $C_{12}H_{25}COONa$
C. $C_{14}H_{29}COONa$
D. $C_{11}H_{23}COONa$
E. $C_{12}H_{25}COOK$

9. To calculate the HLB, the Griffin equation is written as follows:

A. $HLB = 7 - \Sigma\ HLB_{\text{hydrophilic}} - \Sigma\ HLB_{\text{hydrophobic}}$
B. $HLB = 7 + \Sigma\ HLB_{\text{hydrophilic}} - \Sigma\ HLB_{\text{hydrophobic}}$
C. $HLB = 7 - \Sigma\ HLB_{\text{hydrophilic}} + \Sigma\ HLB_{\text{hydrophobic}}$
D. $HLB = 14 + \Sigma\ HLB_{\text{hydrophilic}} - \Sigma\ HLB_{\text{hydrophobic}}$
E. $HLB = \Sigma\ HLB_{\text{hydrophilic}} - \Sigma\ HLB_{\text{hydrophobic}}$

5. Electric double layer and electrokinetic phenomena

1. Under what conditions does the EDL structure correspond to the theory of Helmholtz and Perrin?

A. in dilute solutions
B. when the temperature rises
C. in the case of low-charged sols
D. in concentrated solutions of electrolytes
E. in acid solutions

2. What forces are taken into account in the Gui-Chapman theory?

adsorptive
electrostatic
adsorptive and diffuse
diffusion (thermal movement)
electrostatic and diffuse

3. Under what conditions does the EDL structure correspond to the Gui-Chapman theory?

A. when the temperature drops
B. in the case of highly charged sols
C. in dilute solutions
D. in concentrated solutions
E. in solutions of non-indifferent electrolytes

4. What parts does EDL according to Stern's theory consist of?

A. only diffuse layer
B. only the adsorption layer
C. dense and diffusion part
D. depends on the nature of the contacting phases
E. there is no single answer

5. Is it possible to experimentally determine the interphase potential jump?

A. no, it can only be calculated theoretically
B. can be determined experimentally
C. everything depends on the nature of the phases

D. can be determined experimentally only under certain conditions
E. all answers are wrong

6. Indicate the equation for calculating the thickness of the diffuse part of the EDL:

A. $\xi = \frac{\eta U_{эф}}{\varepsilon \cdot \varepsilon_0}$

B. $\delta = \frac{1}{ZF}\sqrt{\frac{\varepsilon RT}{8\pi c}}$

C. $\delta = \frac{\varepsilon}{4\pi\eta}\varphi_0$

D. $\delta = \frac{\varepsilon RTc}{2\pi}$

E. $\xi = \frac{\delta \cdot V_{эф}}{J \cdot \varepsilon}$

7. What is the electrokinetic potential?

A. interphase potential jump
B. potential of the plane of closest approximation
C. potential drop in the dense part of the EDL
D. potential at the plane of phase slipping
E. is characteristic only for capillary systems

8. What determines the thickness of the diffuse part of the EDL?

A. particle charge sign
B. sign of charge interphase potential jump
C. the nature of the dispersed phase particles
D. electrolyte concentration
E. the particle size of the sol;

9. How does the ζ-potential of negatively charged particles change when potassium and calcium nitrates are introduced into the sol?

A. does not change
B. increases
C. goes through the maximum
D. decreases

E. passes through the minimum;

10. Which of the ions will cause a large decrease of the ζ-potential of negatively charged particles AgJ?

A. PO_4^{3-}
B. K^+
C. J^-
D. NO_3^-
E. Al^{3+}

11. Which of the given series of ions will be potential-determining in relation to the negatively charged AgCl sol?

A. Cl^-; NO_3^-; SO_4^{2-}; CO_3^{2-}
B. Cl^-; Br^-; CNS^-; $Cr_2O_7^{2-}$
C. PO_4^{3-}; NO_3^-; ClO^-; MnO_4^-
D. Ag^+; K^+; CNS^-; PO_4^{3-}; JO_3^-
E. CH_3COO^-; F^-; OH^-; S^{2-}

12. What ions will cause a change in the sign of the charge of a positively charged sol $Fe(OH)_3$?

A. NO_3^-;
B. Cl^-
C. CNS^-;
D. SO_4^{2-};
E. PO_4^{3-}

13. Which of the equations is used to calculate the ζ-potential in the electrophoretic method of determination?

A. $\xi = \dfrac{s \cdot l}{\tau}$

B. $\xi = \dfrac{\eta \cdot \chi}{\varepsilon \cdot \varepsilon_0}$

C. $\xi = \dfrac{U_{эф}}{\tau}$

D. $\xi = \dfrac{\eta U_{эф}}{\varepsilon \cdot \varepsilon_0}$

E. all answers are wrong

14. What electrokinetic phenomena are observed when an electric field is applied to a dispersed system?

A. streaming potential
B. subsidence potential and electroosmosis
C. electrophoresis and flow potential
D. electrophoresis and electroosmosis
E. potential flow and electroosmosis

15. What phenomenon is caused by the mechanical movement of the dispersed phase relative to the dispersion medium?

A. streaming potential
B. sedimentation potential
C. electrophoresis
D. electroosmosis
E. no phenomenon is observed

16. Sol AgJ was obtained by adding 5 ml of 0.05 mol/L KJ to 8 ml of 0.01 mol/L AgNO3. What is the sign of the charge of AgJ sol particles?

A. particles are not charged
B. sol is not formed
C. charged positively
D. complies with IET
E. charged negatively

17. How are the particles of Fe $(OH)_3$ sol charged if Fe^{3+}, Cl^- ions are present in the solution?

A. the charge is zero
B. positive
C. negative
D. the charge of the sol is independent of the presence of these ions
E. under these conditions, no sol is formed

18. How can the sign of the charge of particles of a positive sol of iron hydroxide Fe $(OH)_3$ be changed?

A. adding HCl;
B. adding FeCl3
C. adding NaOH
D. adding Fe_2SO_4
E. charge sign cannot be changed

19. How will the particles of the suspension of quartz SiO_2 be charged in the region pH = 5-8?

A. correspond to IET
B. positive
C. particles are not charged
D. negative
E. particle dissolution occurs

20. What phenomenon is caused by movement of the dispersion medium under the action of electric field?

A. streaming potential
B. sedimentation potential
C. electrophoresis
D. electroosmosis
E. no phenomenon is observed

21. What formula corresponds to a micelle of a positively charged Fe $(OH)_3$ sol obtained by hydrolysis of $FeC1_3$?

A. $\{[mFe(OH)_3]nOH^-(n-x)K^+\}xK^+$
B. $\{[mFe(OH)_3]nCl^-(n-x)K^+\}xK^+$
C. $\{[mFe(OH)_3]nFeO^+(n-x)Cl^-\}xCl^-$
D. $\{[mFe(OH)_3]nFe^+(n-x)OH^-\}xOH^-$
E. $\{[mFe(OH)_3]nCl^-(n-x)Fe^{3+}\}xFe^{3+}$

22. What formula corresponds to a micelle of a positively charged Fe $(OH)_3$ sol obtained by the reaction of NaOH exchange with an excess of $FeC1_3$?

A. $\{[mFe(OH)_3]nOH^-(n-x)K^+\}xK^+$
B. $\{[mFe(OH)_3]nCl^-(n-x)H^+\}xH^+$
C. $\{[mFe(OH)_3]nFeO^+(n-x)Cl^-\}xCl^-$
D. $\{[mFe(OH)_3]nFe^{3+}(n-x)Cl^-\}xCl^-$
E. $\{[mFe(OH)_3]nCl^-(n-x)Fe^+\}xFe^+$

23. Indicate the formula of the micelle of AgJ sol obtained in excess of KJ:

A. $\{[m(AgJ)]nAg^{+}(n-x)NO_3^{-}\}x\ NO_3^{-}$
B. $\{[m(AgJ)]n\ NO_3^{-}(n-x)NO_3^{-}\}x\ Ag^{+}$
C. $\{[m(AgJ)]nJ^{-}(n-x)K^{+}\}x\ K^{+}$
D. $\{[m(AgJ)]nK^{+}(n-x)J^{-}\}x\ J^{-}$
E. $\{[m(AgJ)]nAg^{+}(n-x)J^{-}\}x\ J^{-}$

24. Indicate the formula for a micelle of AgJ sol obtained in an excess of $AgNO_3$:

A. $\{[m(AgJ)]nAg^{+}(n-x)NO_3^{-}\}x\ NO_3^{-}$
B. $\{[m(AgJ)]n\ NO_3^{-}(n-x)NO_3^{-}\}x\ Ag^{+}$
C. $\{[m(AgJ)]nJ^{-}(n-x)K^{+}\}x\ K^{+}$
D. $\{[m(AgJ)]nK^{+}(n-x)J^{-}\}x\ J^{-}$
E. $\{[m(AgJ)]nAg^{+}(n-x)J^{-}\}x\ J^{-}$

25. Indicate the formula for a micelle of AgCl sol obtained in an excess of $AgNO_3$:

A. $\{[m(AgCl)]nCl^{-}(n-x)Na^{+}\}x\ Na^{+}$
B. $\{[m(AgCl)]nNa^{+}\ (n-x)\ Cl^{-}\}x\ Cl^{-}$
C. $\{[m(AgCl)]nAg^{+}\ (n-x)\ NO_3^{-}\}x\ NO_3^{-}$
D. $\{[m(AgJ)]n\ NO_3^{-}(n-x)Ag^{+}\}x\ Ag^{+}$
E. $\{[m(AgJ)]nAg^{+}(n-x)Cl^{-}\}x\ Cl^{-}$

26. Indicate the formula for a micelle of AgCl sol obtained in an excess of NaCl:

A. $\{[m(AgCl)]nCl^{-}(n-x)Na^{+}\}x\ Na^{+}$
B. $\{[m(AgCl)]nNa^{+}\ (n-x)\ Cl^{-}\}x\ Cl^{-}$
C. $\{[m(AgCl)]nAg^{+}\ (n-x)\ NO_3^{-}\}x\ NO_3^{-}$
D. $\{[m(AgJ)]n\ NO_3^{-}(n-x)Ag^{+}\}x\ Ag^{+}$
E. $\{[m(AgJ)]nAg^{+}(n-x)Cl^{-}\}x\ Cl^{-}$

27. Indicate the formula for a micelle of SiO2 hydrosol:

A. $\{[m(SiO_2)]n\ SiO_3^{2-}(n-x)H^{+}\}x\ H^{+}$
B. $\{[m(SiO_2)]n\ H^{+}\ (n-x)\ SiO_3^{2-}\}x\ SiO_3^{2-}$
C. $\{[m(SiO_2)]n\ SiO_3^{2-}\cdot 2(n-x)H^{+}\}\ 2x\ H^{+}$
D. $\{[m(SiO_2)]2n\ H^{+}\ (n-x)\ SiO_3^{2-}\}x\ SiO_3^{2-}$
E. $\{[m(SiO_2)]2n\ H^{+}\ 2(n-x)\ SiO_3^{2-}\}2x\ SiO_3^{2-}$

28. Write the formula for a micelle of $BaSO_4$ sol obtained with an excess of $BaCl_2$:

A. $\{[m(BaSO_4)]nBa^{2+}\ 2(n-x)\ Cl^-\}2x\ Cl^-$
B. $\{[m(BaSO_4)]nCl^-\ (n-x)\ Ba^{2+}\}x\ Ba^{2+}$
C. $\{[m(BaSO_4)]2nCl^-\ (n-x)\ Ba^{2+}\}2x\ Ba^{2+}$
D. $\{[m(BaSO_4)]n\ SO_4^{2-}\ 2(n-x)\ K^+\}2x\ K^+$
E. $\{[m(BaSO_4)]2n\ K^+2(n-x)\ SO_4^{2-}\}x\ SO_4^{2-}$

29. Write the formula for a micelle of $BaSO_4$ sol obtained with an excess of K_2SO_4:

A. $\{[m(BaSO_4)]nBa^{2+}\ 2(n-x)\ Cl^-\}x\ Cl^-$
B. $\{[m(BaSO_4)]nCl^-\ (n-x)\ Ba^{2+}\}x\ Ba^{2+}$
C. $\{[m(BaSO_4)]2nCl^-\ (n-x)\ Ba^{2+}\}2x\ Ba^{2+}$
D. $\{[m(BaSO_4)]n\ SO_4^{2-}\ 2(n-x)\ K^+\}2x\ K^+$
E. $\{[m(BaSO_4)]2n\ K^+2(n-x)\ SO_4^{2-}\}x\ SO_4^{2-}$

30. The gold sol is obtained using the following reduction reaction: $2KAuO_2+2HCHO + K_2CO_3 \rightarrow 2Au + 3HCOOK + KHCO_3$. Indicate the formula of Au sol micelle.

A. $\{[mAu]n\ AuO_2^-\ 2(n-x)\ K^+\}2x\ K^+$
B. $\{[mAu]n\ AuO_2^-\ (n-x)\ K^+\}x\ K^+$
C. $\{[mAu]n\ K^+\ 2(n-x)\ AuO_2^-\}x\ AuO_2^-$
D. $\{[mAu]n\ K^+\ (n-x)\ AuO_2^-\}x\ AuO_2^-$
E. $\{[mAu]n\ AuO_2^-\ 3(n-x)\ K^-\}3x\ K^-$

31. The sulfur sol is obtained by the oxidation reaction: $H_2S + O_2 \rightarrow 2S + H_2O$, as a result of which polythionic acid is formed. Indicate the formula of the sulfur sol micelle.

A. $\{m[S]n\ S^{2-}\ 2(n-x)\ H^+\}2x\ H^+$
B. $\{m[S]n\ S^{2-}\ (n-x)\ H^+\}x\ H^+$
C. $\{m[S]n\ S_5O_6^{2-}\ 2(n-x)\ H^+\}2x\ H^+$
D. $\{m[S]n\ S_5O_6^{2-}\ (n-x)\ H^+\}x\ H^+$
E. $\{m[S]n\ H^+\ (n-x)\ S_5O_6^{2-}\}x\ S_5O_6^{2-}$

32. Prussian blue sol was obtained by the reaction:
$4FeCl_3+3K_4[Fe(CN)_6] \rightarrow Fe_4[Fe(CN)_6]_3 +12KCl$. $FeCl_3$ is taken in excess. Indicate the sol micelle formula.

A. $\{m\ [Fe_4[Fe(CN)_6]]n\ Cl^-\ (n-x)\ Fe^{3+}\}x\ Fe^{3+}$
B. $\{m\ [Fe_4[Fe(CN)_6]]3n\ Cl^-\ (n-x)\ Fe^{3+}\}x\ Fe^{3+}$
C. $\{m\ [Fe_4[Fe(CN)_6]]n\ Fe^{3+}\ 3(n-x)\ Cl^-\}3x\ Cl^-$
D. $\{m\ [Fe_4[Fe(CN)_6]]m\ Fe(CN)_6^{4-}\ 4(n-x)\ K^+\}4x\ K^+$
E. $\{m\ [Fe_4[Fe(CN)_6]]4m\ K^+\ (n-x)\ Fe(CN)_6^{4+}\}4x\ Fe(CN)_6^{4+}$

33. The reaction $4FeCl_3+3K_4[Fe(CN)_6] \rightarrow Fe_4[Fe(CN)_6]_3 +12KCl$ was carried out in an excess of $K_4[Fe\ (CN)_6]$. Indicate the sol micelle formula.

A. $\{m\ [Fe_4[Fe(CN)_6]]n\ Cl^-\ (n-x)\ Fe^{3+}\}x\ Fe^{3+}$
B. $\{m\ [Fe_4[Fe(CN)_6]]3n\ Cl^-\ (n-x)\ Fe^{3+}\}x\ Fe^{3+}$
C. $\{m\ [Fe_4[Fe(CN)_6]]n\ Fe^{3+}\ 3(n-x)\ Cl^-\}3x\ Cl^-$
D. $\{m\ [Fe_4[Fe(CN)_6]]m\ Fe(CN)_6^{4-}\ 4(n-x)\ K^+\}4x\ K^+$
E. $\{m\ [Fe_4[Fe(CN)_6]]4m\ K^+\ (n-x)\ Fe(CN)_6^{4+}\}4x\ Fe(CN)_6^{4+}$

34. The PbS sol was obtained in excess of $Pb(NO)_3$. Indicate the correct micelle shape of the sol

A. $\{m[(PbS)]nPb^{2+}2(n-x)NO_3^-\}2xNO_3^-$
B. $\{m[(PbS)]nS^{2-}2(n-x)K^+\}2xK^+$
C. $\{m[(PbS)]nNO_3^-2(n-x)Pb^{2+}\}2xPb^{2+}$
D. $\{m[(PbS)]nK^+2(n-x)S^{2-}\}2xS^{2-}$
E. $\{m[(PbS)]nPb^{2+}2(n-x)S^{2-}\}2xS^{2-}$

35. The PbS sol was obtained in excess of K_2S. Indicate the correct micelle shape of the sol

A. $\{m[(PbS)]nPb^{2+}2(n-x)NO_3^-\}2xNO_3^-$
B. $\{m[(PbS)]nS^{2-}2(n-x)K^+\}2xK^+$
C. $\{m[(PbS)]nNO_3^-2(n-x)Pb^{2+}\}2xPb^{2+}$
D. $\{m[(PbS)]nK^+2(n-x)S^{2-}\}2xS^{2-}$
E. $\{m[(PbS)]nPb^{2+}2(n-x)S^{2-}\}2xS^{2-}$

36. Sol $Ca_3(PO_4)_2$ is obtained as a result of the exchange reaction between $CaCl_2$ and H_3PO_4, and $CaCl_2$ is taken in excess. Indicate the correct sol micelle formula.

A. $\{m[(Ca_3(PO_4)_2]nCa^{2+}2(n-x)Cl^-\}2xCl^-$

B. $\{m[(Ca_3(PO_4)_2]nCl^- 2(n-x)Ca^{2+}\}2xCl^-$
C. $\{m[(Ca_3(PO_4)_2]nPO_4^{3-} 2(n-x)H^+\}3xH^+$
D. $\{m[(Ca_3(PO_4)_2]nH^+(n-x)PO_4^{3-}\}xPO_4^{3-}$
E. $\{m[(Ca_3(PO_4)_2]nH^+(n-x)PO_4^{3-}\}xPO_4^{3-}$

37**. The $Ca_3(PO4)_2$ sol was obtained as a result of an exchange reaction between $CaCl_2$ and H_3PO_4, with H_3PO_4 taken in excess. Indicate the correct sol micelle formula.**

A. $\{m[(Ca_3(PO_4)_2]nCa^{2+} 2(n-x)Cl^-\}2xCl^-$
B. $\{m[(Ca_3(PO_4)_2]nCl^- 2(n-x)Ca^{2+}\}2xCl^-$
C. $\{m[(Ca_3(PO_4)_2]nPO_4^{3-} 3(n-x)H^+\}3xH^+$
D. $\{m[(Ca_3(PO_4)_2]nH^+(n-x)PO_4^{3-}\}xPO_4^{3-}$
E. $\{m[(Ca_3(PO_4)_2]nH^+(n-x)PO_4^{3-}\}xPO_4^{3-}$

38. The mechanism of formation of EDL of dispersed particles:

A. particle solvation
B. selective adsorption of ions and dissociation of surface molecules of particles
C. physical adsorption of ions on particle surfaces
D. changes in the viscosity of the dispersed system
E. polarization of dispersed phase particles

39. When does the sreaming potential arise?

A. with directional movement of particles of the dispersed phase
B. when forcing a liquid through a capillary-porous system
C. when an electric field is applied to a single capillary
D. when the particles of the dispersed phase settle under the action of gravity
E. when shaking the dispersed phase particles

40. What ions are called as potential-determining ions of sols?

A. charge determining ions of the sol micelle
B. only multivalent cations
C. only multivalent anions
D. H + and OH- ions
E. all answers are wrong

41. What is observed in the isoelectric state of a gelatin solution (amphoteric polyelectrolyte)?

A. suppression of dissociation of carboxyl groups
B. suppression of dissociation of amine groups
C. the number of dissociated carboxyl and amine groups is equal to each other
D. increased dissociation of carboxyl and amine groups
E. suppression of carboxyl dissociation and increased dissociation of amine groups

42. What electrokinetic phenomena are observed when an electric field is applied to a dispersed system?

A. flow potential
B. subsidence potential
C. electrophoresis and flow potential
D. electrophoresis and electroosmosis
E. flow potential and subsidence potential

43. How does the thickness of the EDL change with increasing temperature?

A. decreases
B. increases
C. goes through the maximum
D. passes through the minimum
E. does not change

44. How does the ζ-potential of a sol change with an increase of temperature?

A. increases
B. decreases
C. does not change
D. reaches a constant value
E. approaching zero

45. How does the electrokinetic potential change when the diffusion part of the EDL of a colloidal particle is compressed?

A. increases
B. decreases
C. remains unchanged

D. increases to a certain value
E. increases infinitely

46. Directed motion of charged particles of the dispersed phase in an electric field is called:

A. electroosmosis
B. dialysis
C. osmosis
D. electrophoresis
E. sedimentation

47. Under what condition is a negatively charged silver iodide sol formed? (KJ, $AgNO_3$ - starting reagents)

A. $C_{KJ} = C_{AgNO_3}$
B. $C_{KJ} \rangle C_{AgNO_3}$
C. $C_{KJ} \langle C_{AgNO_3}$
D. $C_{KJ} = 20\%$
E. $C_{KJ} = 3\%$

48. The state of a colloidal solution in which the electrokinetic potential of a colloidal particle is zero is called as:

A. isoelectric
B. charged
C. thermodynamically stable
D. equilibrium
E. diffusion

49. How does the ζ-potential of colloidal particles change with an increase in the concentration of an indifferent electrolyte?

A. does not change
B. increases
C. goes through the maximum
D. decreases
E. passes through the minimum

50. Which of the following electrolytes will be non-indifferent to AgJ sol?

A. $NaNO_3$; KNO_3; $Ca(NO_3)_2$;
B. NaCl; $AgNO_3$; KJ
C. K_2SO_4; $Ca(NO_3)_2$; K_2CO_3
D. Na_2CO_4; NH_4NO_3; NH_4Cl
E. $Ba(NO_3)_2$; Na_2SO_4; $BaCl_2$

51. What aqueous solutions of the following substances will cause a change in the sign of the electrokinetic potential of a negative sulfur sol?

A. K_2SO_4
B. $Ag(NO_3)_3$
C. KNO_3
D. NH_4Cl
E. $Cu(NO_3)_3$

52. Which of the following surfactants causes a change in the sign of the electrokinetic potential of the positive AgJ sol?

A. $C_{12}H_{25}OSO_3Na$
B. $C_{16}H_{33}(CH_3)_3NCl$
C. $C_{17}H_{35}(CH_3)_3NBr$
D. C_4H_9OH
E. HCOOH

53. **Electrophoresis is the process of movement of ______ under the action of external current:**

A. cations
C. particles of dispersed phase
B. anions;
D. particles of the dispersion medium
E. all answers are incorrect

54. Electroosmosis is the process of transition of _______under the action of external electric field:

A. granular
B. particles of the dispersed phase

C. micelles
D. dispersion medium
E. all answers are incorrect

55. Electrokinetic ζ-potential arises:

A. at the boundary of the nucleus and potential-determining ions;
B. at the boundary of the adsorption and diffusion layers
C. on the border of potential-determining ions and counterions
D. on the border of micelles with a dispersed medium
E. all answers are incorrect

56. The value of ζ-potential has an effect on the stability of lyophobic solis as following:

A. increases stability
B. reduces stability
C. does not change stability;
D. the effect depends on the nature of a sol
E. all answers are incorrect

57. The structural unit of colloidal particle of lyophobic sols is:

A. the unit;
B. the nucleus;
C. micelles;
D. granules
E. particle

58. The sign of the charge of colloidal particles is determined by:

A. counterions
B. potential-determining ions
C. ions of diffion layer
D. solvent ions
E. nucleus

59. The formula of micelles formed during the interaction of barium chloride with excess of potassium sulfate:

A. $\{[\mathrm{mBaSO4}]\ \mathrm{n\ SO_4^{2-}}\ 2(\mathrm{n}-\mathrm{x})\mathrm{K^+}\}^{2\mathrm{x}-}\ 2\mathrm{xK^+}$

B. $\{[mBaSO_4]$ n Ba^{2+} $2(n–x)CI^{-}\}^{2x+}$ $2xCI^{-}$
C. $\{[mBaSO_4]$ n $SO_4^{2–}$ $(n–x)K^{+}\}^{2x–}$ xK^{+}
D. $\{[mBaSO_4]$ n $SO_4^{2–}$ $2K^{+}\}^{2x}K^{+}$
E. $\{[mBaSO_4]$ n Ba^{+} $(n–x)CI^{-}\}^{2x}+$ $2xCI^{-}$

60. The formula of micelles formed during the interaction of silver iodide with excess of silver nitrate:

A. $\{m[AgI] \cdot n\ NO^{3–} \cdot (n\text{-}x)\ Ag^{+}\}^{x–} \cdot x\ Ag^{+}$,
B. $\{m[AgI] \cdot nAg^{+} \cdot (n\text{-}x)NO_3^{–}\}^{x+} \cdot x\ NO_3^{–}$;
C. $\{m[AgI] \cdot nI– \cdot (n\text{-}x)K+\}^{x–} \cdot x\ K+$;
D. $\{m[AgI] \cdot nK+ \cdot (n\text{-}x)\ I–\ \}^{x+} \cdot xI–$
E. $\{m[AgI] \cdot nAg+ \cdot 3(n\text{-}x)NO_3^{–}\}^{x+} \cdot 3\ x\ NO_3^{–}$;

6. Stability of lyophobic systems

1. What process is called as coagulation?

A. adhesion of dispersed particles under the influence of electrolytes
B. sedimentation of coarse particles by gravity
C. adhesion of dispersed particles under the influence of only strong acids
D. adhesion of particles of opposite charge
E. adhesion of liquid droplets under the influence of alkalis

2. What substances are used as stabilizers for hydrophobic sols?

A. unsaturated hydrocarbons
B. aromatic hydrocarbons
C. surfactants
D. surface inactive agents
E. surface-indifferent substances

3. How does the coagulating ability of ions change with increasing charge?

A. does not change
B. increases
C. decreases
D. goes through the maximum
E. passes through the minimum

4. How does the coagulation critical concentration change with decreasing ion charge?

A. decreases
B. increases
C. does not change
D. passes through the minimum
E. passes through the maximum

5. In what cases is the phenomenon of "wrong rows" observed?

A. at coagulation with monovalent ions
B. with coagulation with mixtures of electrolytes
C. with coagulation with two valence ions
D. at coagulation with multiply charged ions

E. with acid coagulation

6. Rapid coagulation is called as

A. coagulation with dilute electrolyte solutions
B. coagulation with mixtures of electrolytes
C. coagulation, in which all particle collisions result in adhesion
D. coagulation, in which there is a rapid enlargement of particles
E. coagulation, during which precipitation of particles of the dispersed phase occurs

7. Mutual coagulation is:

A. coagulation of oppositely charged particles
B. coagulation of positively charged particles
C. coagulation of negatively charged particles
D. coagulation with mixtures of electrolytes
E. all answers are correct

8. The theory of the kinetics of rapid coagulation was developed by:

A. Langmuir I.
B. Dumansky A.V.
C. Deryagin B.V.
D. Smoluchowski
E. Nernst V.

9. The theory of the kinetics of slow coagulation was developed:

A. Langmuir I.
B. Fuchs N.A.
C. Deryagin B.V.
D. Martynov E.M.
E. Mueller V.M.

10. What ion causes the coagulation?

A. only cation
B. anion only
C. an ion with sign is opposite to that of colloidal particles
D. only multiply charged ion
E. complex ion

11. Flocculation is a process:

A. adhesion of particles in the presence of electrolyte
B. stabilization of the dispersed system using surfactants
C. formation of loose aggregates of particles as a result of the formation of bridges between particles during the adsorption of macromolecules
D. particle settling by gravity
E. interactions of particles of a dispersed phase having an elongated shape (ellipse, filaments, rods)

12. In the case of which of the dispersed systems given below electrolytes do not have a coagulating effect?

A. hydrosols AgI, AgCl
B. slurries of clays and quartz
C. polystyrene latex hydrosols
D. suspensions of paraffin, fluoroplastic
E. stabilized direct emulsions

13. In the case of which of the following systems does $Ca(NO_3)_2$ solution have the greatest coagulating effect?

A. positively charged sols AgI, AgCl
B. suspensions of clays and quartz
C. positively charged
D. suspensions of paraffin, fluoroplastic
E. inverse emulsions

14. The best coagulants for negatively charged polystyrene latex sol are:

A. $Al(NO_3)_3$, $Ca(NO_3)_2$
B. K_2SO_4, Na_3PO_4
C. $Al(NO_3)_3$, Na_3PO_4
D. KI, $BaCl_2$
E. $LiNO_3$, $LiPO_4$

15. What are the types of stability of dispersed systems:

A. kinetic and thermodynamic
B. aggregation and sedimentation

C. gravity and hypsometric
D. high and low
E. hydrodynamic and Stokes

16. What is the difference between lyophilic and lyophobic colloidal systems ?

A. there is no significant difference
B. lyophilic colloidal systems are not wetted by liquid, and lyophilic colloidal systems are wetted by liquid
C. lyophilic colloidal systems - thermodynamically stable and spontaneously dispersed, and lyophobic colloidal systems are thermodynamically unstable, not spontaneously dispersed
D. only soap-like substances belong to lyophilic colloidal systems, and the rest of the dispersions to lyophobic colloidal systems
E. lyophilic colloidal systems are solvated and lyophobic colloidal systems are hydrated

17. Two main methods for preparation of lyophobic disperse systems:

A. crushing, recrystallization
B. dissolution, chemical condensation
C. physical condensation, dissolution
D. dispersion, condensation
E. peptization, recrystallization

18. How does the charge of the coagulating ion affect the rapid coagulation critical concentration?

A. with an increase of the charge of coagulating ion, the coagulation critical concentration decreases
B. with an increase of the charge of coagulating ion, the coagulation critical concentration increases
C. with an increase of the charge of coagulating ion, the coagulation critical concentration first decreases and then increases
D. with an increase of the charge of coagulating ion, the coagulation critical concentration does not change
E. with an increase of the charge of coagulating ion, the coagulation critical concentration first increases and then decreases

19. What is called as a slow coagulation?

A. particle coarsening is slower

B. slow settling of large aggregates
C. not all collisions of solid colloidal particles lead to their sticking together
D. slow separation of the colloidal system into two phases
E. slow adhesion of colloidal particles

20. What is the reason for the aggregative instability of lyophobic disperse systems?

A. the formation of thick solvation layers
B. excess surface energy, thermodynamically nonequilibrium state
C. thin solvation layer, low particle charge density
D. weak stabilizer, particles react poorly with the medium
E. weak structural and mechanical barrier and increased van der Waals attraction

21. In what ways can coagulation of the lyophobic colloidal system be induced?

A. addition of electrolytes, various physical factors (cooling, heating, etc.)
B. adding only alkalis
C. adding only acids
D. loss of sedimentation stability of dispersed systems
E. aggregation of solids

22. When is neutralization coagulation of lyophobic sols observed?

A. when a strong acid or alkali is added, depending on the nature of the dispersion
B. in the case of low-charged sols
C. when adding weak electrolytes
D. when added to strongly charged sols of strong electrolytes
E. all answers are wrong

23. What factors are responsible for the aggregative stability of lyophobic dispersed systems?

A. electrostatic, adsorption-solvate, electrolyte
B. structural-mechanical, electrostatic, entropic
C. hydrodynamic, structural-mechanical, electrostatic
D. thermodynamic, kinetic, hydrodynamic
E. Marangoni-Gibbs effect, kinetic, entropy

24. What colloidal system does butter belong to?

A. solid emulsion

B. direct emulsion
C. reverse emulsion
D. solid colloid
E. all answers are inaccurate

25. At the addition of mixtures of electrolytes to the suspension the coagulation of the system increases, then it is called as

A. heterocoagulation
B. heteroadagulation
C. syneresis
D. synergism
E. rheopexy

26. What is the coagulation critical concentration?

A. start of particle adhesion
B. start of oil droplet fusion
C. minimum concentration of polyelectrolyte at which solid particles begin to stick together
D. minimum electrolyte concentration at which solid particles begin to stick together
E. the minimum concentration of hydrogen ions at which solid particles begin to stick together

27. What is a flocculation critical concentration?

A. start of particle adhesion
B. start of oil droplet fusion
C. minimum concentration of polyelectrolyte at which solid particles begin to stick together
D. minimum electrolyte concentration at which solid particles begin to stick together
E. the minimum concentration of hydrogen ions at which solid particles begin to stick together

28. What is the reason for the stability of lyophilic colloidal system?

A. electrostatic factor
B. adsorption-solvation factor
C. structural and mechanical factor
D. hydrodynamic factor
E. entropy factor

29. Who proposed the adsorption theory of coagulation of sols with electrolytes?

A. Müller
B. Rabinovich and Kargin
C. Freundlich
D. Pauli and Duclos
E. Picton and Linder

30. Who proposed the electrostatic theory of coagulation of sols with electrolytes?

A. Müller
B. Rabinovich and Kargin
C. Freundlich
D. Pauli and Duclos
E. Picton and Linder

31. Who proposed the chemical theory of coagulation of sols with electrolytes?

A. Müller
B. Rabinovich and Kargin
C. Freundlich
D. Pauli and Duclaux
E. Picton and Linder

32. Who proposed the physical theory of coagulation of sols with electrolytes?

A. Müller
B. Rabinovich and Kargin
C. Freundlich
D. Pauli and Duclaux
E. Deryagin and Landau

33. Which of these ions Li^+, Na^+, K^+, Rb^+ and Cs^+ have the lowest coagulation critical concentration?

A. Li^+
B. K^+
C. Rb^+
D. Cs^+
E. Na^+

34. Which of these ions Li^+, Na^+, K^+, Rb^+ and Cs^+ have the highest coagulation critical concentration?

A. Li^+
B. K^+
C. Rb^+
D. Cs^+
E. Na^+

35. The influence of the radius of monovalent ions on their coagulating ability is expressed by the lyotropic series:

A. $Li^+<Na^+<K^+<Rb^+<Cs^+$
B. $Li^+<Na^+<Rb^+<Cs^+<K^+$
C. $Cs^+<K^+< Na^+<Rb^+<Li^+$
D. $Cs^+<Rb^+<K^+< Na^+< Li^+$
E. $Li^+<Cs^+<Rb^+< Na^+<K^+$

36. Which of these ions Be^{2+}, Mg^{2+}, Ca^{2+}, Ba^{2+} and Sr^{2+} have the lowest coagulation critical concentration?

A. Be^{2+}
B. Ca^{2+}
C. Ba^{2+}
D. Sr^{2+}
E. Mg^{2+}

37. Which of these ions Be^{2+}, Mg^{2+}, Ca^{2+}, Ba^{2+} and Sr^{2+} have the highest coagulation critical concentration?

A. Be^{2+}
B. Ca^{2+}
C. Ba^{2+}
D. Sr^{2+}
E. Mg^{2+}

38. Which of these salts Na_2SO_4, $CaCl_2$, $Ca(NO_3)_2$, $Fe_2(SO_4)_3$ have the lowest coagulation critical concentration in relation to the negative MnO_2 sol?

A. Na_2SO_4

B. $Ca(NO_3)_2$
C. $CaCl_2$
D. all the listed salts have the same coagulation threshold
E. $Fe_2(SO_4)_3$

39. Sedimentation analysis is applied for?

A. for ultramicroheterogeneous systems
B. for fine systems
C. for monodisperse systems
D. for polydisperse systems
E. for coarse systems

40. How can the percentage of particle fraction be determined?

A. by along the sedimentation curve of a polydisperse system
B. by the integral curve of particle size distribution
C. along the slope of the bidispersed system
D. from the value of the constant subsidence
E. analytical method only

41. Centrifugal sedimentation analysis is applied for?

A. for ultramicroheterogeneous systems
B. for fine systems
C. for monodisperse systems
D. for polydisperse systems
E. for coarse systems

42. How are aerosols classified?

A. by particle size, by appearance
B. by the state of aggregation of the dispersed phase, by dispersion and by methods of preparation
C. by dispersion, liquid and solid
D. gaseous, liquid and solid
E. by particle size and practical application

43. What colloidal systems are characterized by neutralization coagulation?

A. for highly charged particles

B. for weakly charged particles
C. for suspensions
D. for emulsions
E. for aerosols

44. What colloidal systems are characterized by concentration electrolyte coagulation?

A. for highly charged particles
B. for weakly charged particles
C. for suspensions
D. for emulsions
E. for aerosols

45. What electrolytes are added with alternation of stability and instability zones of lyophobic sols?

A. monovalent electrolytes
B. strong electrolytes
C. weak electrolytes
D. multivalent electrolytes
E. strong acids

46. If the violation of the stability of the sol with the addition of electrolyte occurs in the near potential minimum, then it is called

A. neutralizing coagulation
B. concentration coagulation
C. reversible coagulation
D. irreversible coagulation
E. spontaneous coagulation

47. If the violation of the stability of the sol with the addition of electrolyte occurs in the far potential minimum, then it is called

A. neutralizing coagulation
B. rapid coagulation
C. reversible coagulation
D. irreversible coagulation
E. slow coagulation

48. Which of the following surfactants has a stronger stabilizing action for the positive AgI sol?

A. sodium dodecylsulfate
B. sodium decylsulfate
C. sodium ethylsulfate
D. sodium octisulfate
E. sodium amylsulfate

49. The strong stabilization factor for emulsions and foams is

A. structural and mechanical barrier according to Rehbinder
B. Marangoni-Gibbs effect
C. adsorption-solvation factor
D. steric protection
E. entropy factor

50. For which colloidal systems is the Smoluchowski equation of rapid coagulation applicable?

A. for polydisperse systems
B. for monodisperse systems
C. for any dispersed systems
D. for coarse systems
E. for fine systems

51. What emulsifiers are used to stabilize the oil-in-water emulsion O/W?

A. casein
B. multivalent metal soaps
C. rubber
D. clay particles
E. all answers are correct

52. The aggregation stability of suspensions is due to:

A. particle size
B. dispersion degree
C. Brownian motion of particles
D. the presence of a double electric layer on the surface of the particles of the dispersed phase

E. all answers are correct

53. The process of breaking of emulsions is called as:

A. sedimentation
B. coagulation
C. coalescence
D. peptization
E. all answers are correct

54. One can break down the foams:

A. reduce surface tension
B. increase the temperature
C. add surfactants
D. decrease the temperature
E. all answers are incorrect

55. What kind of stability do suspensions have?

A. aggregation
B. kinetic
C. kinetic and aggregation
D. absolutely unstable
E. all answers are incorrect

56. What emulsifiers are used to stabilize emulsions like O/W:

A. clay
B. resins
C. alkali metal soaps
D. water soluble metal soaps
E. all answers are incorrect

57. The stability of disperse systems is:

A. the ability to maintain the degree of dispersion and uniform distribution of particles of the dispersed phase
B. resistance to the movement of particles in an electric field
C. resistance to Brownian motion
D. the ability to maintain the constant pH

E. stability to the shaking of solution

58. Sedimentation stability of disperse systems is the stability of particles:

A. to a change the pH
B. to settle down under action of gravity
C. to a change the surface tension
D. the formation of larger aggregates
E. to change the turbidity of system

59. Aggregation stability of dispersed systems is:

A. the ability to maintain the particle size
B. a resistance to pH changes
C. a resistance to changes in surface tension
D. the ability to form particles of a certain size
E. a stability to settle

60. Coagulation is the process of:

A. the movement of colloidal particles in an electric field
B. combining o particles into larger aggregates
C. light scattering
D. diffusion of colloids
E. settling under action of gravity

61. Coagulating action is provided by:

A. ions oppositely charged to the granule
B. any cations and anions
C. only cations
D. anions only
E. ions with same charge to the granule

62. Coagulation of sols by electrolytes obeys the rule of:

A. Schulze – Hardy
B. Paneth – Fajans
C. Van't Hoff
D. Duclaux – Traube
E. Deryaguin-Landau

63. Coagulating ability of electrolyte with an increase of the charge of coagulating ion:

A. does not change
B. decreases
C. increases
D. does not have a clear relationship
E. does not observed

64. Mutual coagulation is:

A. the process of sedimentation of colloidal particles when adding a mixture of electrolytes
B. the formation of a precipitate when mixing colloids with the same sign of the particle charge
C. the formation of a precipitate when mixing colloids with different signs of particle charge
D. coagulation process when adding electrolyte in small portions
E. aggregation of ions

65. Two liquids that form the emulsion must:

A. wet well
B. be polar
C. be non-polar
D. do not mix
E. organic

66. Colloidal protection is a:

A. method for preparation of sols
B. the method for purification of sols
C. the ability of some substances to protect the sol from coagulation
D. the ability of colloids to protect the HMC (high molecular weight compounds) from coagulation
E. the dialysis of sols

67. Similarly to colloidal solutions the HMC (high molecular weight compounds) solutions:

A. are not spontaneously formed
B. do not pass through the semi-permeable membranes
C. irreversible
D. heterogeneous
E. homogeneous

7. Structure formation and viscosity of disperse systems

1. What is the classification of disperse systems according to their structural and mechanical properties suggested by Rebinder?

A. coagulation and crystallization
B. Newtonian and non-Newtonian
C. pseudoplastic and dilatant
D. condensation-crystallization
E. liquid and solid

2. Which section of the potential interaction curve corresponds to the formation of coagulation structures?

A. maximum
B. near potential minimum
C. far potential minimum
D. maximum and far potential minimum
E. maximum and near potential minimum

3. What are the reasons for the formation of condensation structures?

A. interaction of particles through the layers of a dispersion medium, as a result of coagulation of a dispersed system
B. direct chemical interaction between particles and their accretion as a result of coagulation
C. complete loss of aggregate stability of the system
D. Pressing out liquid dispersion medium
E. change in external conditions for the existence of the system

4. What are the reasons for the formation of coagulation-thixotropic-reversible structures?

A. elongated shape of particles and physical interaction between them
B. direct chemical interaction between particles and their accretion as a result of coagulation
C. complete loss of aggregate stability of the system
D. Pressing out liquid dispersion medium
E. change in external conditions for the existence of the system

5. Which of the disperse systems are considered as coagulation structures?

A. gelatin; iron hydroxide sol; cement; the soil
B. clay dough; cement; cell protoplasm; alloys
C. ceramics; alloys; quicksands; oil paint
D. cement; glass; the soil; gelatin gel
E. protoplasm of the cell; clay dough; quicksands; oil paint

6. Which of the presented disperse systems belong to crystallization-condensation structures?

A. silver sol; alloys; cell protoplasm; latexes
B. cement; glass; egg white; the soil
C. cement; glass; alloys
D. plastics; metals; alabaster; clay dough
E. ceramics; latexes; alloys; ebonite

7. What is a "thixotropy" phenomenon?

A. the ability of a system to restore a structure in time after its mechanical destruction
B. the process of reducing the supersaturation and reducing internal stresses
C. transition from coagulation structures to condensation-crystallization
D. the ability of a system to become unstable due to mechanical stress
E. ability of the system to direct chemical interaction between particles and their accretion with the formation of a rigid bulk structure

8. What is a “syneresis”?

A. increase in structure strength with time under the action of shear stress
B. decrease in viscosity with increasing shear stress
C. development of plastic deformations, growing indefinitely, at $P > P_T$
D. aging in time, which manifests itself in the gradual hardening of the structure, its compression and the release of part of the liquid from the structural part
E. irreversible protein deposition and coagulation, in which the initial specific configuration is disrupted

9. What equation describes the Newton's perfectly viscous body?

A. $P=E \bullet \gamma$
B. $P=P_T$

C. $P=\eta\frac{d\gamma}{dx}\tau$

D. $P=P_0e^{-\tau/\lambda}$

E. $\gamma=\frac{P}{E}+\frac{P}{\eta}\tau$

10. Indicate which equation describes the Bingham viscoplastic body model?

A. $P=\eta\frac{d\gamma}{dx}$

B. $P=E\gamma$

C. $P=P_0e^{-\tau/\lambda}$

D. $\gamma=\frac{P}{E}+\frac{P}{\eta}\tau$

E. $P=P_T+\eta\frac{d\gamma}{d\tau}$

11. Indicate which of the given expressions corresponds to the Einstein equation describing the viscosity of liquid aggregatively stable disperse systems?

A. $P=E\cdot\gamma$

B. $[\eta]=KM^a$

C. $\eta=\frac{P}{d\gamma/dx}$

D. $\eta*=\frac{P-Pk}{d\gamma/dx}$

E. $\eta=\eta_0(1+2,5\varphi)$

References

1. Shchukin E.D., Pertsov A.V., Amelina E.A., Zelenev A.Z. Colloid and surface chemistry / Elsevier, 2001. – 747 p.
2. Show D. J. Introduction to colloid and surface chemistry 4th. – 2003 – 306 p.
3. Омарова К.И., Коканбаев А.К., Мусабеков К.Б. Поверхностные явления и дисперсные системы (рабочая программа и тестовые задания на казахском и русском языках) – Алматы: Қазақ университеті, 2007 – 102 с.
4. Сумм Б.Д. Основы коллоидной химии / М.: «Академия», 2007. – 238 с.
5. Назаров В.В., Гродский А.С., Моргунов А.Ф., Шабанова Н.А., Кривощеков А.Ф., Колосов А.Ю. Практикум и задачник по коллоидной химии. Поверхностные явления и дисперсные системы / В.В.Назаров, А.С. Гродский. – М.: ИКЦ «Академкнига», 2007. – 374 с.
6. Фридрихсберг Д.А. Курс коллоидной химии. Санкт-Петер-бург: Химия. 1995. 368 с.
7. https://www.ck12.org/na/test-colloids-and-classification-1/lesson/Colloids-and-Classification-xii-chemistry/#
8. https://link.springer.com/referenceworkentry/10.1007%2F978-3-642-20665-8_40
9. Tadros T. Surfactants. In: Tadros T. (eds) Encyclopedia of Colloid and Interface Science. Springer, Berlin, Heidelberg. 2013. https://doi.org/10.1007/978-3-642-20665-8_40
10. Гафуров Б.А., Усмонова У.Х. Тестовые вопросы к экзамену по физической и коллоидной химии для студентов 1-го курса ХГМУ, 2016. – 34с. http://khatmedun.tj/1.pdf
11. https://refnew.ru/testi-po-kolloidnoj-himii-v-kakom-intervale-izmenyayutsya-razm.html

Keys for MCQ

1. Peculiarities, preparation and purification of dispersed systems

№ Number of question	Number of topic	Correct answer
1	1	A
2.	1	B
3.	1	C
4.	1	C
5.	1	C
6.	1	B
7.	1	C
8.	1	B
9.	1	A
10.	1	C
11.	1	A
12.	1	C
13.	1	D
14.	1	D
15.	1	D
16.	1	B
17.	1	A
18.	1	B
19.	1	A
20.	1	B
21.	1	A
22.	1	A
23.	1	B
24.	1	D
25.	1	D
26.	1	D
27.	1	B
28.	1	A
29.	1	D
30.	1	D
31.	1	A
32.	1	D
33.	1	D
34.	1	D

35.	1	D
36.	1	D
37.	1	C
38.	1	B
39.	1	A
40.	1	B
41.	1	C
42.	1	C
43.	1	D
44.	1	E
45.	1	A
46.	1	B
47.	1	C
48.	1	C
49.	1	E
50.	1	D
51.	1	A
52.	1	D
53.	1	B
54.	1	B
55.	1	C
56.	1	C
57.	1	B
58.	1	C
59.	1	C
60.	1	D
61.	1	B
62.	1	D
63.	1	B
64.	1	A
65.	1	B
66.	1	A
67.	1	A
68.	1	D

2. Molecular kinetic and optical properties of disperse systems

№ Number of question	Number of topic	Correct answer
1	2	A

2.	2	A
3.	2	B
4.	2	C
5.	2	B
6.	2	E
7.	2	B
8.	2	D
9.	2	D
10.	2	C
11.	2	B
12.	2	B
13.	2	B
14.	2	C
15.	2	B
16.	2	D
17.	2	D
18.	2	B
19.	2	C
20.	2	B
21.	2	A
22.	2	C
23.	2	C
24.	2	C
25.	2	B
26.	2	C
27.	2	B
28.	2	B
29.	2	B
30.	2	A

3. Surface phenomena and surface layers, adsorption

№ Number of question	Number of topic	Correct answer
1	3	C
2.	3	D
3.	3	C
4.	3	A
5.	3	A
6.	3	B

7.	3	B
8.	3	C
9.	3	A
10.	3	B
11.	3	C
12.	3	A
13.	3	D
14.	3	B
15.	3	B
16.	3	A
17.	3	B
18.	3	A
19.	3	B
20.	3	A
21.	3	D
22.	3	C
23.	3	B
24.	3	C
25.	3	B
26.	3	B
27.	3	A
28.	3	B
29.	3	B
30.	3	B
31.	3	C
32.	3	C
33.	3	A
34.	3	C
35.	3	E
36.	3	A
37.	3	B
38.	3	A
39.	3	A
40.	3	A
41.	3	D
42.	3	D
43.	3	A
44.	3	E
45.	3	A
46.	3	A

47.	3	A
48.	3	E
49.	3	A
50.	3	E
51.	3	A
52.	3	B
53.	3	A
54.	3	B
55.	3	B
56.	3	C
57.	3	C
58.	3	C
59.	3	C
60.	3	B
61.	3	C
62.	3	D
63.	3	B
64.	3	B
65.	3	D
66.	3	B
67.	3	A
68.	3	A
69.	3	B
70.	3	B
71.	3	A
72.	3	A
73.	3	B
74.	3	A
75.	3	B
76.	3	A
77.	3	C
78.	3	B
79.	3	A
80.	3	A
81.	3	C
82.	3	B
83.	3	D
84.	3	D
85.	3	D
86.	3	C

87.	3	E
88.	3	C
89.	3	C
90.	3	A
91.	3	A
92.	3	C
93.	3	B
94.	3	C
95.	3	A
96.	3	C
97.	3	C
98.	3	A
99.	3	D
100.	3	A
101.	3	B

4. Lyophilic systems

1	4	D
2.	4	C
3.	4	B
4.	4	C
5.	4	D
6.	4	A
7.	4	C
8.	4	A
9.	4	B

5. Electric double layer and electrokinetic phenomena

№ Number of question	Number of topic	Correct answer
1	5	D
2.	5	D
3.	5	C
4.	5	C
5.	5	A
6.	5	B
7.	5	D
8.	5	D

9.	5	D
10.	5	E
11.	5	B
12.	5	E
13.	5	D
14.	5	D
15.	5	B
16.	5	E
17.	5	B
18.	5	C
19.	5	D
20.	5	D
21.	5	C
22.	5	D
23.	5	C
24.	5	A
25.	5	C
26.	5	A
27.	5	C
28.	5	A
29.	5	D
30.	5	B
31.	5	C
32.	5	C
33.	5	D
34.	5	A
35.	5	B
36.	5	A
37.	5	C
38.	5	B
39.	5	B
40.	5	A
41.	5	C
42.	5	D
43.	5	B
44.	5	A
45.	5	B
46.	5	D
47.	5	C
48.	5	A

49.	5	D
50.	5	B
51.	5	B
52.	5	A
53.	5	D
54.	5	D
55.	5	B
56.	5	A
57.	5	C
58.	5	B
59.	5	A
60.	5	B

6. Stability of lyophobic systems

№ Number of question	Number of topic	Correct answer
1	6	A
2.	6	C
3.	6	B
4.	6	A
5.	6	D
6.	6	C
7.	6	A
8.	6	D
9.	6	B
10.	6	C
11.	6	C
12.	6	D
13.	6	B
14.	6	A
15.	6	B
16.	6	C
17.	6	D
18.	6	A
19.	6	C
20.	6	B
21.	6	A
22.	6	B
23.	6	B

24.	6	B
25.	6	D
26.	6	D
27.	6	C
28.	6	B
29.	6	C
30.	6	A
31.	6	D
32.	6	E
33.	6	D
34.	6	A
35.	6	A
36.	6	C
37.	6	A
38.	6	E
39.	6	E
40.	6	B
41.	6	A
42.	6	B
43.	6	B
44.	6	A
45.	6	D
46.	6	D
47.	6	C
48.	6	A
49.	6	A
50.	6	B
51.	6	A
52.	6	D
53.	6	C
54.	6	D
55.	6	D
56.	6	A
57.	6	A
58.	6	B
59.	5	A
60.	5	B
61	6	A
62	6	A
63	6	C

64	6	C
65	6	D
66	6	C
67	6	D

7. Structure formation and viscosity of disperse systems

№ Number of question	Number of topic	Correct answer
1	7	A
2.	7	C
3.	7	B
4.	7	A
5.	7	E
6.	7	C
7.	7	A
8.	7	D
9.	7	C
10.	7	E
11.	7	E

CONTENTS