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**ORGANIZATION OF KNOWLEDGE CONTROL  
ON THE SUBJECT «GENERAL AND INORGANIC CHEMISTRY»  
IN STUDENTS STUDY IN ENGLISH**

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Pedagogical diagnostics of students' knowledge and skills are obligatory condition the organization of educational process. The systematic control of knowledge fosters in students a responsible attitude to studies, allowing them to identify individual characteristics and apply a differentiated approach in training. Pedagogical control is reliable information about students' achievements in the subject being studied and the gaps in their preparation, can manage the learning process.

Pedagogical diagnostics of students' knowledge on the subject "General and Inorganic Chemistry" has a place for each topic studied in the laboratory and practical classes, as well as during the semester held a thematic control knowledge in the form of implementation of control work.

In this article, I presented the contents of a thematic control work that provides a model program on the subject. During preparation for the thematic control knowledge under the chapter "Laws of chemical processes" the student must repeat the following program questions:

1) Equivalent. The equivalents law. Determination of the molar mass of an equivalent of element, simple and complex substances. Calculations of the molar mass of an equivalent in acid-base and redox reactions.

2) Subject and problems of chemical thermodynamics. Interrelation between processes of a metabolism and energy in an organism. Chemical thermodynamics is a

theoretical basis of a bioenergetics.

3) The basic concepts of thermodynamics. Internal energy. Work and heat – two forms of energy transmission. Types of thermodynamic systems and processes. Enthalpy. Standard enthalpy changes of formation, standard enthalpy changes of combustion. The Hess's law of heat summation. Thermochemical processes. Reversible and nonreversible processes in thermodynamic sense. Entropy. Standard entropy. Gibbs free energy. The standard Gibbs free energy of formation.

4) A chemical equilibrium. Reversible and nonreversible reaction. A constant of a chemical equilibrium and ways of its expression:  $K_p$ ,  $K_c$ ,  $K_a$ . The equation of isotherm of chemical reaction. To predict a shift of a chemical equilibrium, according to a Le Chatelier's principle.

5) Chemical kinetics as a basis for study of rates and mechanisms of biochemical processes. Reactions simple and composite, homogeneous and heterogeneous. The mass action law for reaction rate. The effect of temperature on a reaction rate. The Arrhenius equation.

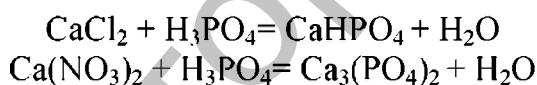
*Control work*

*Variant 1*

1. Enthalpy. Standard enthalpy changes of formation, standard enthalpy changes of combustion.

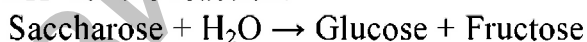
2. Concentration and reaction rate. Mass action law for rate of the chemical reaction. Rate constant.

3. Calculate the molar mass of an equivalent of phosphoric acid in the following reactions:



4. Calculate the molar mass of an equivalent of oxidizing and reducing agents in the following reaction:  $\text{Fe}_2\text{O}_3 + \text{CO} \rightarrow \text{CO}_2 + 2\text{FeO}$

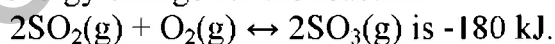
5. What is value of  $\Delta H^\circ$  for the reaction:



The  $\Delta H_f^\circ$  (saccharose) = -222,7 kJ/mol,  $\Delta H_f^\circ$  ( $\text{H}_2\text{O}$ ) = -241,8 kJ/mol

$\Delta H_f^\circ$  (fructose) = -1006 kJ/mol,  $\Delta H_f^\circ$  (glucose) = -1274,5 kJ/mol

6. The standard free energy change for the reaction



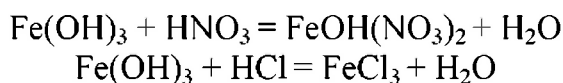
Calculate the equilibrium constant (K) for this reaction at 300 K.

*Variant 2*

1. The Hess's law of heat summation. Thermochemical processes.

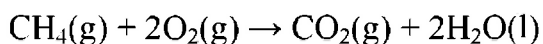
2. The effect of temperature on a reaction rate. A temperature coefficient of reaction rate and its peculiarities for biochemical processes. The Arrhenius equation.

3. Calculate the molar mass of an equivalent of iron(III) hydroxide in the following reactions:



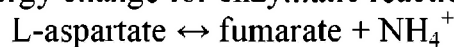
4. Calculate the molar mass of an equivalent of oxidizing and reducing agents in the following reaction:  $\text{PbS} + \text{HNO}_3 \rightarrow \text{Pb}(\text{NO}_3)_2 + \text{NO}_2 + \text{S} + \text{H}_2\text{O}$ .

5. Calculate the enthalpy change for chemical reaction



if  $\Delta H_f^\circ (\text{CH}_4) = -74,85 \text{ kJ/mol}$ ,  $\Delta H_f^\circ (\text{CO}_2) = -393,5 \text{ kJ/mol}$ ,  $\Delta H_f^\circ (\text{H}_2\text{O}) = -285,9 \text{ kJ/mol}$

6. Calculate the free-energy change for enzymatic reaction



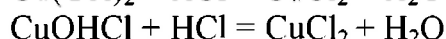
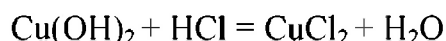
if the equilibrium constant (K) is  $1,6 \cdot 10^{-2}$  and  $39^\circ\text{C}$ .

*Variant 3*

1. Entropy. Standard entropy. Boltzmann's entropy formula.

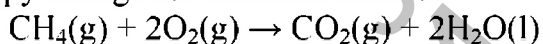
2. Chemical equilibrium. Reversible and nonreversible reactions. Examples.

3. Calculate the molar mass of an equivalent of  $\text{Cu}(\text{OH})_2$  and  $\text{CuOHCl}$  in the following reactions:



4. Calculate the molar mass of an equivalent of oxidizing and reducing agents in the following reaction:  $\text{Al} + \text{HNO}_3 \rightarrow \text{Al}(\text{NO}_3)_3 + \text{N}_2 + \text{H}_2\text{O}$ .

5. Calculate the entropy change for chemical reaction



$S^\circ(\text{CH}_4) = 186,3 \text{ J/mol}\cdot\text{K}$ ,  $S^\circ(\text{O}_2) = 205,0 \text{ J/mol}\cdot\text{K}$

$S^\circ(\text{CO}_2) = 213 \text{ J/mol}\cdot\text{K}$ ,  $S^\circ(\text{H}_2\text{O}) = 69,94 \text{ J/mol}\cdot\text{K}$

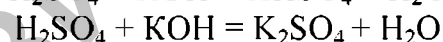
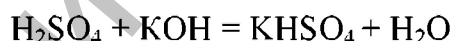
6. The equilibrium concentrations of  $\text{H}_2$ ,  $\text{J}_2$  and  $\text{HJ}$  are 0,25, 0,05 and 0,9 mol/l respectively. Calculate the free-energy change of reaction:  $\text{H}_2 + \text{J}_2 \leftrightarrow \text{HJ}$

*Variant 4*

1. Spontaneity and Free Energy.

2. Homogeneous and heterogeneous catalysis. Examples.

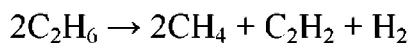
3. Calculate the molar mass of an equivalent of sulphuric acid in the following reactions:



4. Calculate the molar mass of an equivalent of oxidizing and reducing agents in the following reaction:



5. Calculate the  $\Delta H^\circ$  of reaction:



if the  $\Delta H^\circ$  of combustion  $\text{C}_2\text{H}_6$ ,  $\text{CH}_4$ ,  $\text{C}_2\text{H}_2$  and  $\text{H}_2$  are -1560, -890.2, -1299.0, -285,83 kJ/mol correspondingly.

6.  $\Delta G^\circ$  for the reaction  $\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \leftrightarrow 2\text{NO}(\text{g})$  is 173,1 kJ. Calculate the value of the equilibrium constant for this reaction at  $25^\circ\text{C}$ .

Control of knowledge plays important role in activation the educational activities of foreign students, as many of them have revealed a lack of a responsible attitude to learning, lack of motivation to study general professional disciplines, aborted skills of educational work.