УДК 378.016:54

СОДЕРЖАНИЕ САМОСТОЯТЕЛЬНОЙ РАБОТЫ ИНОСТРАННЫХ СТУДЕНТОВ ПО ОБЩЕЙ ХИМИИ (НА ПРИМЕРЕ ТЕМЫ «CHEMICAL THERMODYNAMICS AND BIOENERGETICS»)

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Подготовка высококвалифицированных кадров, решающих профессиональные задачи любой сложности, является неотъемлемым условием реформирования системы высшего образования и здравоохранения. В связи с этим возрастает роль преподавателя в организации самостоятельной работы студентов. Учитывая, что самостоятельная работа – это вид учебно-познавательной деятельности по освоению профессиональной образовательной программы, осуществляемой в определенной системе, при участии преподавателя в ее планировании и оценке результатов, можно говорить лишь об определенной степени самостоятельности студентов при выполнении различных видов самостоятельных работ, т.е. об управляемой самостоятельной работе.

Для организации управляемой самостоятельной работы студентов лечебного факультета, обучающихся на английском языке, по учебной дисциплине «Общая химия» на кафедре общей, физической и коллоидной химии определены: 1) основные направления, содержание, формы и методы подготовки студентов к самостоятельной деятельности; 2) конкретное содержание, объем материала, подлежащий самостоятельному изучению в соответствии с учебной программой; 3) способ изложения учебного материала в методической литературе (учебных пособиях, методических указаниях и др.) в доступной для эффективного усвоения студентами форме.

Кафедра обеспечивает контроль организации и качества выполнения самостоятельной работы студентов; составляет график самостоятельной работы для студентов и срок выполнения работ; анализирует ее эффективность и вносит коррективы с целью активизации и совершенствования самостоятельной работы студентов; обеспечивает доступность всего необходимого учебно-методического и справочного материала; разрабатывает методические рекомендации, пособия по организации самостоятельной работы студентов, задания для самостоятельной работы; вопросы к экзаменам, зачетам и другим контрольным мероприятиям.

На кафедре разработаны методические указания по подготовке студентов к занятиям по учебной дисциплине «Общая химия», в которых определены основные направления самостоятельной работы студентов по подготовке к занятиям. Методические указания по определенной теме включают: медико-биологическое значение темы, чтобы мотивировать студентов на ее изучение, программные вопросы, литературу, описание лабораторных опытов, оформление протоколов, которых студенты должны осуществить самостоятельно, а также вопросы для самоконтроля подготовки к занятиям и кратко изложенный теоретический материал.

Рассмотрим содержание самостоятельной работы студентов на примере темы: *«Chemical thermodynamics and bioenergetics»*.

Medicobiological value of theme: the thermodynamics is the theoretical basis of a modern bioenergetics – science which study legitimacy of accumulation, keeping and using of energy by alive systems.

Since the change of energy does not depend on way of process, but only from an initial and final state of system, therefore there is no necessity to know true mechanism of reactions occurring in alive organisms (cells). It is possibleto simulate them outside of an organism. So, it was possible to establish on model experience, with the help of thermodynamic calculations, that at multiphase process of an oxidizing of nutritious substances in an organism the same quantity of energy precipitates out, as well as at their immediate burning outside of an organism. It allows to establish connection between a calorific of nutrition and serviceability of an organism. These connection is a base of scientific dietology. The model operation of various biochemical processes can be carried out at various temperatures distinguished from that, at which they proceed in an organism, anduseing the relevant equations of thermodynamics it is possible to count change of energy in substantial requirements.

The thermochemical investigation of processes of an oxidizing of various products in alive organisms are necessary not only for study of mechanisms of transformation of various substances in energy. The comparison of energetics healthy and patients of cells allows to develop early diagnostics of various diseases and check behind their current. The diseases of the man are always accompanied by change of values of thermodynamic parameters describing a sectional organism in norm. So, occurrence and the course of diseases is accompanied by increasing of entropy system. The increasing of entropy is marked also at development of processes of neogenesis and embryogenesis.

The application of the basic laws of thermodynamics allows to establish specific features of an alive nature, to prognosticate a direction of spontaneous course of processes in an organism and their depth depending on requirements, to predict an possibility of participation of this or that medicinal substance in the necessary reaction proceeding in biological medium, and relevant bioenergy changes.

Knowledge of thermodynamic legitimacies and skill to apply them for decision of concrete practical questions it is necessary for study of the following chapters of these course (chemical kinetics and equilibrium, theory of solutions, electrochemistry, physico-chemistry of surface phenomenas), and also for study of biochemistry, physiology both other medicobiological and clinical disciplines.

To lesson it is necessary:

TO STUDY the following program questions: a 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.

The basic concepts of thermodynamics. Internal energy. Work and heat – two forms of energy transmission. Types of thermodynamic systems and processes.

The first low of thermodynamics. Enthalpy. Standard enthalpy changes of formation, standard enthalpy changes of combustion. The Hess´s law of heat summation. Thermochemical processes. Application of the first law of thermodynamics to biosystems.

The second law of thermodynamics. Reversible and nonreversible in

thermodynamic sense processes. Entropy. Standard entropy. Gibbs´s free energy. The standard Gibbs free energy of formation. The standard Gibbs´s free energy of a biological oxidizing. The chemical potential.

Measure of a direction of spontaneous processes.

Research work:
"Definition the heat of neutralization reaction"
Starting dates

Mass of an interior glassful of a calorimeter m_1, g .....
Volumes of solutions of reactants V, ml .....
Concentration of solutions C, mol / l ... ...
Density of solutions ρ, g/ml ... ...
Specific heat of water Cm (H_2O) – 4,184 J / (g • K)
Specific heat of glass Cm (gl) – 0,753 J / (g • K)

1. By measuring cylinder measure 30 ml of solutions of a strong acid and strong basis.

2. Measure temperature of one of solutions, for example base, is immediate in the cylinder by the thermometer. After that wash the thermometer by distilled water and again insert into a calorimeter.

3. Add a solution of an acid through a funnel to an interior glassful of a calorimeter and also write down its temperature.

4. Add the solution of base prompt in a calorimeter to a solution of an acid and mix.

5. Within several seconds observe for level of mercury in the thermometer and write down the highest indication.

6. The obtained experimental data write down in the table under the shape:

The measured and calculated quantities	Reactants
Temperature of a solution of an acid T_a	
Temperature of a solution of the basis T_b	
Reference temperature of experience $T_1 = 0,5 (T_a + T_b)$	
Best temperature after mixture T_2	
$\Delta T = T_2 - T_1$	
Q, kJ	
ΔH_c, kJ/mol	

Processing of results of experiment

1) Calculate the heat capacity of a calorimeter Cm, taking into account a heat capacity of a solution and calorific capacity of an interior glassful:

$Cm = Cm (gl) • m (gl) + Cm (H_2O) • m (sol)$,

Where m (sol) – mass of a solution in a calorimeter calculated on volume of a solution and density (Density can be accepted peer 1 g/ml).

2) Calculate the heat, allocated in a calorimeter:

$Q = Cm\Delta T$.

This heat gradually in accordance with alignment of temperature is transmitted in a surrounding medium and can be accepted peer on absolute value to change of enthalpy of system (calorimeter) – ΔH_c:

$\Delta H_c = -Q$.

3) For calculation of reaction heat ΔH_r the found value of heat count on 1 of a mol reacting acid or basis, that corresponds 1 of mol of generatored water:

$$\Delta H_r = \frac{\Delta H_c}{n} = \frac{\Delta H_c}{cV},$$

Where n – chemical quantity of one of substances participating in reaction.

Problems for discussion

1. What is: a) an exothermic reaction, b) an endothermic reaction?

Give two examples of each.

2. Discuss some different forms of energy and give examples of their conversions.

3. What is meant by a "system"in thermodynamics?

4. Define "enthalpy change for a system".

5. What is the difference, if any, between "enthalpy of formation"and "enthalpy of reaction"?

6. What is the difference, if any, between ΔH_f and ΔH_f^o.

7. Write an equation relating the heat of a reaction and the heats of formation of the reactants and the products of the reaction.

8. For the metabolism of sugar, $C_{12}H_{22}O_{11}$, in the body, $\Delta H = -5645$ kJ mol^{-1}. How many kilocalories (Ccal) of energy would your body gain from the sugar in a candy bar that has the mass of 150.0 g and contains 60.0 percent sugar and no other nutrients?

9. The combustion of benzene is represented by the equation

$$C_6H_6(l) + 7\frac{1}{2}O_2(g) \rightarrow 6CO_2(g) + 3H_2O(l)$$

Using the standard data to four significant figures, calculate the standard enthalpy of combustion of benzene.

10. The combustion of octane occurs according to the equation

$$2C_8H_{18}(l) + 25O_2(g) \rightarrow 16CO_2(g) + 18H_2O(l)$$

The standard enthalpy for this reaction as written is $-1{,}094 \cdot 10^4$ kJ. Using the standard data, calculate the standard enthalpy of formation of octane.

11. What is a "spontaneous process"? Give examples of some spontaneous and of some nonspontaneous prosesses.

12. What is entropy? Give examples of some systems of law entropy and others of higher entropy.

13. State the second law of thermodynamics.

14. In thermodynamics, what is a "reversible" process?

15. What is the Gibb's free energy? Write an eguation for the Gibb's free energy of a system un terms of the change, the entropy change, and the temperature of the system.

16. What is the relationship between the free energy change of a reaction and the

spontaneously of the reaction?

17. Write an equation for calculating the standard free energy change for a reaction from the values of the standard free energies of formation for the reactants and products.

18. Show how you would calculate the standard free energy change for a reaction from given values of standard enthalpies of formation and standard absolute entropies for the reactants and the products.

19. Predict the sign of ΔS for each of the following reactions and give a reason for each prediction:

(a) $AgCl(s) \rightarrow Ag^+(aq) + Cl^-(aq)$; (b) $2Na(s) + Cl_2(g) \rightarrow 2NaCl(s)$;

(c) $H_2(g) + I_2(g) \rightarrow 2HI(g)$; (d) $H_2(g) + I_2(s) \rightarrow 2HI(g)$;

(e) $2H_2O_2(l) \rightarrow 2H_2O(l) + O_2(g)$.

20.Using S^0 values, calculate ΔS^0 for each of the following reactions:

(a) $N_2(g) + 2O_2(g) \rightarrow 2NO_2(g)$;

(b) $CO_2(g) + H_2(g) \rightarrow CO(g) + H_2O(g)$.

21.Calculate ΔG^0 for each of the following reactions using the values for ΔH^0_f and S^0:

(a) $N_2(g) + 2O_2(g) \rightarrow 2NO_2(g)$;

(b) $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$.

22.Calculate ΔG^0 for each of the following reactions using the values of ΔG^0_f:

(a) $2H_2O_2(l) \rightarrow 2H_2O(l) + O_2(g)$;

(b) $NH_4Cl(s) \rightarrow NH_3(g) + HCl(g)$.

Таким образом, в ходе реализации управляемой самостоятельной работы у студентов в течение учебного года формируются умения поиска оптимальных вариантов ответов, расчетов, решений ситуационных задач по общей химии; навыки выполнения учебного исследования, развиваются навыки работы с учебником, учебными пособиями, современной научной литературой.