Рабочий лист № 5

Subject: **“Chemical equilibrium”**

Theoretical part

Vocabulary

- Найдите соответствие, запишите слова в словарную тетрадь.

to predict	вероятность/осуществимость	appropriate	содержать
the composition	молчать	inside	преобразование
to modify	регулировать	close	константа равновесия
conditions	коэффициент реакции	to adopt	обратная реакция
avoidance	биологическое стандартное состояние	to label	самопроизвольный
attainment	равновесие	reactants	катализатор
feasibility	обычный/стандартный	to be related by	помечать
to be silent	достижения	converting	соответствующий
to adjust	модифицироватьт/видоизменять	catalyst	реагенты
reaction quotient	предотвращение	spontaneous	внутри
Biological standard state	состав	reverse reaction	принимать
equilibrium	условия	the equilibrium constant	близко, около, рядом
conventional	предсказывать	to contain	связаны с

- Составьте 3 предложения, употребляя словарные слова.

Examples:*Thermodynamics is silent about the rates of reaction.*

The thermodynamic criterion for spontaneous change at constant temperature and pressure is $\Delta G < 0$.

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Main laws, equations and definitions

- Прочитайте и запишите русские аналоги (воспользуйтесь конспектами лекций, учебником, интернетом).

The criterion for chemical equilibrium is_____

_____

_____

The chemical potential:_____

Reaction quotient, Q:_____

Equilibrium constant (K) of the reaction:_____

Le Chatelier’s principle:_____

_____

- **The presence of a catalyst**

- **The effect of temperature (Van ’t Hoff equation)**

Practical part and home work

- Прочитайте и переведите на русский язык

(b) Biological standard states

The thermodynamic definition of standard states of solutes takes them as being at unit activity (in elementary work, at $c^\ominus = 1$ mol dm^{-3}). The conventional standard state of hydrogen ions ($a_{H_3O^+} = 1$, corresponding to pH = 0, a strongly acidic solution) is not appropriate to normal biological conditions inside cells, where the pH is close to 7. Therefore, in biochemistry it is common to adopt the biological standard state, in which pH = 7, a neutral solution. When we adopt this convention we label the corresponding standard quantities as $G^\oplus$, $H^\oplus$, and $S^\oplus$.[1] Equation 4.8 allows us to relate the two standard Gibbs energies of formation.

For a reaction of the form

$$\text{reactants} + \nu\, H_3O^+(aq) \rightarrow \text{products}$$

the biological and thermodynamic standard states are related by

$$\Delta_r G^\oplus = \Delta_r G^\ominus - RT \ln(10^{-7})^\nu = \Delta_r G^\ominus + 7\nu RT \ln 10 \qquad \text{(4.8)}$$

Relation between standard values

where we have used the relations $(x^a)^b = x^{ab}$ and $\ln x^{ab} = ab \ln x$. It follows that

at 298.15 K: $\Delta_r G^\oplus = \Delta_r G^\ominus + \nu(39.96 \text{ kJ mol}^{-1})$

at 37°C (310 K, body temperature): $\Delta_r G^\oplus = \Delta_r G^\ominus + \nu(41.5 \text{ kJ mol}^{-1})$

There is no difference between thermodynamic and biological standard values if hydrogen ions are not involved in the reaction ($\nu = 0$).

- Решите задачу

Self-test 4.2 The overall reaction for the glycolysis reaction (*Case study* 4.3) is $C_6H_{12}O_6(aq) + 2\ NAD^+(aq) + 2\ ADP^{3-}(aq) + 2\ HPO_4^{2-}(aq) + 2\ H_2O(l) \rightarrow 2\ CH_3COCO_2^-(aq) + 2\ NADH(aq) + 2\ ATP^{4-}(aq) + 2\ H_3O^+(aq)$. For this reaction, $\Delta_r G^\oplus = -80.6$ kJ mol^{-1} at 298 K. What is the value of $\Delta_r G^\ominus$?

Answer: −0.7 kJ mol^{-1}