



CODE:

(to be filled in by the jury at the end of the test here and on the envelope)

## REGIONAL CHEMISTRY COMPETITION

April 6, 2019

- 1) The tests are stapled with an envelope on the top. In the envelope there is piece of paper on which you should fill in the requested data: name and surname, school, supervisor etc. and then close and **seal the envelope!**
- 2) Do not put any signature, or a mark on the envelope and on the test (the code should be filled in by the jury). If any signature or mark is found on the test or envelope, the competitor will be disqualified.
- 3) You should write on the test using a **blue pen**, answers written with pencil will not be considered.
- 4) A calculator can be used for the numerical problems. It is not allowed to use textbooks, any other book, notebook, paper, the periodic table, cell phone etc. Cell phones should be left on the teacher's desk or out of the test room.
- 5) All necessary data are provided in the test.
- 6) Any conversation between the competitors is forbidden. If you have any question, then the teacher in the room should call the responsible teacher for the competition.
- 7) Read the test carefully and answer the questions following the instructions by: encircling, writing down the solution and answer in the designated space in the test. The jury **will evaluate only the answers written in the designated space for it**, and the procedures for solving the problems will be checked. The back of every page of the test, that is empty, can be used for free writing and it will not be checked and evaluated!
- 8) The maximal number of points is **50**. In the first part of the test with multiple choice questions, each correct answer brings 2 points (maximum 30). The correct answers to the problems in the second part brings maximum 20 points.
- 9) The competition lasts **90 minutes**. The tests that are handed after the given time will not be considered for scoring.

*We wish you a successful work!*

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### For the jury only

Part I: \_\_\_\_\_

Part II: \_\_\_\_\_

Total points: \_\_\_\_\_

Checked by (Name and Surname)

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MULTIPLE CHOICE QUESTIONS TEST WITH ONE CORRECT ANSWER

(Select just one answer A, B, C or D)

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- The extent of a reaction:
  - increases throughout the duration of the reaction.
  - increases in the beginning, but decreases towards the end of the reaction.
  - is 0 at the end of the reaction.
  - decreases throughout the duration of the reaction.
- If the extent of a reaction is smaller than its maximum value, and the quantities of the participants do not change further:
  - the reaction must be “stuck” in a metastable state.
  - the reaction is reversible.
  - the reaction is irreversible.
  - the reaction can occur only in one direction.
- At the end of an irreversible reaction in an elementary act of chemical transformation of which only reactant particles take part:
  - in any case in the system no one of the reactants is present.
  - at least two reactants are absent.
  - at least one reactant is absent.
  - all reactants are present in small but measurable concentrations.
- The exchange of energy between a system and its surroundings:
  - can occur only in a single manner for a given process.
  - can occur in various ways.
  - can not occur through “mediation” of photons (*i.e.* light).
  - can only occur in the form of heat and mechanical work.
- The heat of the process of melting of ice at constant pressure is expressed as:
  - reaction molar enthalpy of melting.
  - reaction molar internal energy of melting.
  - molar enthalpy of melting.
  - molar internal energy of melting.
- The enthalpy of a system:
  - is always larger than the internal energy of the system.
  - is always smaller than the internal energy of the system.
  - can be either larger or smaller than the internal energy of the system.
  - can be negative.
- Condensation of water vapour:
  - is exoenergetic process.
  - is a chemical process.
  - never happens in the absence of a catalyst.
  - is endoenergetic process.
- The rate of change of concentration of a given participant of the reaction during its progress:
  - can be either positive or negative.
  - can never be zero.
  - is a characteristic of the reaction as a whole.
  - can not be determined experimentally.
- An irreversible reaction  $A \rightarrow B$ :
  - in the beginning takes place at higher rate, which diminishes with time.
  - in the beginning takes place at lower rate, which increases with time.
  - in the beginning takes place with a rate close to zero, then the rate becomes larger and at the end the rate is zero.
  - in the beginning takes place at higher rate, which first diminishes with time and at the end increases.
- After completion of a chemical reaction, the catalysts:
  - always undergo chemical changes, while physically they remain unchanged.
  - do not undergo neither chemical nor physical changes in any case.
  - remain chemically unchanged, with same quantities as before the start of the reaction.
  - remain physically unchanged, with different quantities from those before the start of the reaction.
- The products of a chemical reaction:



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- A) can not have the role of catalysts of the reaction.  
B) can have the role of catalysts of the reaction.  
C) maybe can have the role of catalysts of the reaction, but such examples are not known until now.  
D) always have the role of catalysts of the reaction.

12. In an isolated system, a spontaneous process is always accompanied with:

- A) a decrease in entropy.  
B) a decrease in Gibbs energy.  
C) an increase in entropy.  
D) an increase in Gibbs energy.

13. pH of pure water:

- A) is 7.00 under any conditions.  
B) does not depend on the temperature.  
C) depends on the temperature.  
D) can not be lower than 6.90.

14. One substance easily accepts electrons.

The substance that forms in that process:

- A) hardly donates electrons.  
B) easily donates electrons.  
C) hardly donates protons.  
D) easily donates protons.

15. Oxidation numbers:

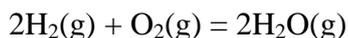
- A) can not be ascribed to atoms within neutral particles.  
B) are zero if the particle as a whole is not electrically charged.  
C) are never equal to the charges of the charged particles.  
D) are directly related to the charges of charged particles.

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### PROBLEMS

(Put the calculations and the answer to the problem at the designated place)

1. Calculate the maximum extent of the reaction:



if it is known that the initial quantities of hydrogen and oxygen are 1.5 mol and 2.0 mol correspondingly.

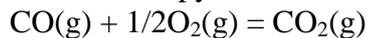
SOLUTION:

ANSWER: \_\_\_\_\_



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2. The enthalpy of the reaction of oxidation of carbon monoxide:



is  $-283,0 \text{ kJ mol}^{-1}$ . What is the quantity of heat that the reaction system will exchange with its surroundings if 0.5 g CO is fully oxidized (in the presence of excess oxygen)? ( $A_r(\text{C}) = 12.0107$ ;  $A_r(\text{O}) = 15.9994$ )

SOLUTION:

ANSWER: \_\_\_\_\_

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3. In a given system a chemical reaction takes place that can be represented with the equation:



In the beginning, the system contained three moles of both reactants. After ten minutes, the quantity of B decreased at half of the initial value. Calculate the rate of conversion ( $J$ ).

SOLUTION:

ANSWER: \_\_\_\_\_



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4. A sample of benzene ( $C_6H_6$ ) is heated at  $80\text{ }^\circ\text{C}$  (*i.e.* to its boiling temperature). The heating is continued by adding  $15.4\text{ kJ}$  heat, which resulted in evaporation of  $39.1\text{ g}$  of benzene. What is the molar enthalpy of evaporation of benzene? ( $A_r(C) = 12.0107$ ;  $A_r(H) = 1.0079$ )

SOLUTION:

ANSWER: \_\_\_\_\_

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