



**Society of Chemists and Technologists of Macedonia**  
Chemistry competitions for elementary and high school students

CODE:

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

FOR THE JURY ONLY

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

Checked by (Name Surname): \_\_\_\_\_

## RULES FOR THE LOCAL CHEMISTRY COMPETITION 2019

- 1) The competition **starts at 10 o'clock and lasts for 60 minutes**. The tests that are handed after the given time will not be considered for scoring.
- 2) The tests are stapled with an envelope on the top. In the envelope there is piece of paper on which every competitor should fill in the requested data: name and surname, school, supervisor etc. and then close (seal) the envelope.
- 3) **No signature, or a mark is allowed on the envelope and on the test**. The code on the test, below and on the envelope, should be filled in by the jury after the test time is over. If any signature or mark is found on the test or envelope, the competitor will be disqualified.
- 4) The competitors should bring a blue pen with them. The test should be solved by this pen only. **It is not allowed to use a pencil.**
- 5) Each competitor should leave the **cell phone** at the teacher's desk at the beginning and take it back at the end after handing over the test.
- 6) A calculator can be used for the numerical problems.
- 7) A conversation between the competitors during the competition is forbidden as well as using books, notebooks, any other paper, the periodic table of the elements etc. All necessary data are given in the test.
- 8) The maximal possible number of points is **50**.
- 9) 2 points are awarded for every correct answer, and for a non-answered or not correctly answered question (more than one answer or crossed-out answer) no points are awarded.
- 10) If the competitor has a question then he calls the responsible teacher in the classroom (testator), who then calls the coordinator by cell phone. The coordinator, in presence of one more teacher, decides if he/she should answer the question of the contestant. The question should be asked quietly and be short and clear. If both teachers decide that the question should be answered, then the coordinator loudly repeats the question and the answer so all contestants in the classroom can hear it. If not, the coordinator loudly says "That is not relevant for the competition".
- 11) A competitor that does not follow any of these rules/recommendations shall be eliminated from the competition.



Select a single answer. For each correct answer you get 2 points. Using a pencil, selecting more than 1 answer and crossing over the answer is not allowed and will not be evaluated.

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MULTIPLE CHOICE QUESTIONS TEST WITH ONE CORRECT ANSWER  
(Select just one answer A, B, C or D)

- The internal energy of a system:
  - is a sum of solely the kinetic and potential energy of the system as a whole.
  - is a sum of solely the kinetic energies of molecules that constitute the system.
  - can be determined in absolute value.
  - depends on system's temperature.
- Enthalpy:
  - is equal to the heat content within a given system.
  - is a path function.
  - is related to the internal energy of the system.
  - does not change when the pressure is constant.
- Evaporation of water:
  - is exothermic process.
  - is chemical process.
  - does not take place in an absence of catalyst.
  - is endoenergetic process.
- Reaction enthalpy:
  - depends on the extent of the reaction.
  - is proportional to the heat of the reaction at constant pressure.
  - is equal to the heat of the reaction at constant volume.
  - does not depend on the temperature.
- The rate of change of concentration:
  - characterizes the rate of the reaction as a whole.
  - can take positive or negative values.
  - depends on the concentration of the given reaction participant.
  - does not change throughout the reaction.
- If the temperature increases by 10 K, the reaction rate:
  - always increases tenfold.
  - decreases in the case of all reactions.
  - cannot decrease in the case of any reaction.
  - in the case of large number of reactions increases twofold to fourfold.
- According to the collision theory:
  - all collisions between the reactant particles are efficient in the sense that they induce their chemical transformation.
  - the collision frequency between the reactant particles does not depend on the reactant's concentrations.
  - the probability of so-called ternary collision, *i.e.* collision between three particles is quite high.
  - only some collisions between the reactant particles are efficient in the sense that they induce their chemical transformation.
- To form the activated complex:
  - the reactant particles do not have to approach each other close enough.
  - the particles do not need to possess enough energy.
  - an energetic barrier has to be overcome.
  - the system's pressure has to be very high.
- Catalysts:
  - can cause a chemical reaction to occur that is otherwise impossible.
  - do not change the reaction path.
  - increase the reactants' energy.
  - do not alter the state of chemical equilibrium.



Select a single answer. For each correct answer you get 2 points. Using a pencil, selecting more than 1 answer and crossing over the answer is not allowed and will not be evaluated.

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10. In biocatalysis (catalysis with enzymes):
- A. only typical characteristics of the homogeneous catalysis are observed.
  - B. higher specificity in comparison to other catalytic reactions is not characteristic.
  - C. it is necessary to have larger quantities of the enzyme in order to have observable changes in the reaction rate.
  - D. the final results is that only one of the possible reactions within the system takes place at significant rate.
11. Spontaneous processes:
- A. always lead the system to a state with the lowest possible energy.
  - B. always enable exchange of substances between the system and the environment.
  - C. are not possible in isolated systems.
  - D. occur in a direction that is determined not only by the energy of the system.
12. A spontaneous process:
- A. can not lead to a decrease of the system's entropy in any case.
  - B. can occur only in an open system.
  - C. increases the system's Gibbs energy.
  - D. occurs in the direction of entropy increase in an isolated system.
13. When chemical equilibrium is attained:
- A. nothing occurs in the system any more, neither microscopically nor macroscopically.
  - B. no noticeable changes in the quantities of the substances occur.
  - C. the entropy has the largest possible value.
  - D. Gibbs energy has the largest possible value.
14. The equilibrium of the reaction of thermal decomposition of calcium carbonate:
- A. can not be influenced in any way.
  - B. can not be "shifted" towards the direction of reactants ("to the left").
  - C. can be "shifted" towards the direction of products ("to the right").
  - D. can be affected only by the change in temperature.
15. In exothermic reactions:
- A. the increase of temperature shifts the equilibrium to the left.
  - B. the increase of temperature shifts the equilibrium to the right.
  - C. the decrease of temperature shifts the equilibrium to the left.
  - D. the increase of temperature does not affect the equilibrium attained.
16. Free protons (*i.e.* hydrogen ions,  $H^+$ ):
- A. do not exist in water solutions.
  - B. can exist only at low temperatures.
  - C. exist at low pH values.
  - D. can exist at various conditions.
17. Strong protolytes:
- A. are substances that easily donate or easily accept protons.
  - B. are substances that hardly donate or hardly accept protons.
  - C. are substances that dissociate strongly.
  - D. are substances that do not take part in protolytic processes.
18. According to Brønsted and Lowry, acid is:
- A. a substance that is a proton-acceptor in a protolytic reaction.
  - B. a substance that is a proton-donor in a protolytic reaction.
  - C. a substance that is an electron-donor.
  - D. a substance that is an electron-acceptor.
19. The solution is neutral if:
- A.  $pH = 7$ , under any conditions.
  - B. a solution of base is added to a solution of acid.
  - C. the concentrations of hydrogen and hydroxide ions are equal.
  - D. the concentration of hydrogen ions is  $10^{-14} \text{ mol dm}^{-3}$ , under any conditions.



Select a single answer. For each correct answer you get 2 points. Using a pencil, selecting more than 1 answer and crossing over the answer is not allowed and will not be evaluated.

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20. Salts formed from a strong acid and a strong base:

- A. hydrolyze forming acidic solution.
- B. hydrolyze forming basic solution.
- C. do not hydrolyze.
- D. it hasn't been surely determined whether they hydrolyze or not.

21. The enthalpy of a system:

- A. does not change when the pressure is constant.
- B. is a path function.
- C. can be determined in absolute value.
- D. depends on the system's temperature.

22. The rate of conversion:

- A. is a quantity that characterizes the reaction as a whole (*i.e.* it does not depend on the reaction participant on the basis of which it has been computed).
- B. is identical with the rate of change of concentration.
- C. can be defined only for irreversible reactions.
- D. it is better to compute its value on the basis of data for reactants.

23. The collision theory:

- A. gives a quite realistic description of the occurrence of a chemical reaction on molecular level.
- B. gives only a pictorial, *i.e.* simplified description of the occurrence of a chemical reaction on molecular level.
- C. shows that the reaction rate does not depend on the concentrations of the participants.
- D. takes into account the electrons of the reactants.

24. The activated complex:

- A. is composed by the particles of one of the reactants and the inert gas in the system.
- B. is formed regardless on the energy of the particles that take part in its formation.
- C. corresponds to the maximum energy of the system along the reaction path.
- D. can not form and still the reaction will occur.

25. In homogeneous catalysis:

- A. the catalysts are not active participants in the chemical reactions that they catalyze.
- B. the reactants should be in the same aggregate state.
- C. the catalyst forms an intermediate compound with one of the reactants.
- D. the catalyst only increases the local concentration of the reactants.