



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. Usage of pencil, selecting more than 1 answer and crossing over the answer is not allowed and will not be evaluated.

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

1. Which of the following electron configurations corresponds to the ground state of the given atom?
- A. C

↑↓	↑↓	↑↓		
1s	2s	2p		
- B. N

↑↓	↑↓	↑	↓	↑
1s	2s	2p		
- C. Be

↑↓	↑	↑		
1s	2s	2p		
- D. O

↑↓	↑↓	↑↓	↑	↑
1s	2s	2p		
2. Which of the following physical quantities is extensive?
- A. Molar volume.
B. Density.
C. Relative atomic mass.
D. Volume.
3. A container with a volume of 1 L contains hydrogen. Under the same conditions, another identical container contains oxygen. If we suppose that the gases behave as ideal, which of the following is true:
- A. $N(\text{O}_2) > N(\text{H}_2)$
B. $N(\text{O}_2) < N(\text{H}_2)$
C. $N(\text{O}_2) = N(\text{H}_2)$
D. There is not enough data to give an answer.
4. The masses of gaseous oxygen and hydrogen, under the same conditions, are identical. If we suppose that the gases behave as ideal, which of the following is true:
- A. $N(\text{O}_2) > N(\text{H}_2)$
B. $N(\text{O}_2) < N(\text{H}_2)$
C. $N(\text{O}_2) = N(\text{H}_2)$
D. There is not enough data to give an answer.
5. Arrange the following gases, CO, CO₂ и H₂S, (all under the same conditions), according to the increasing trend of their density:
- A. CO, CO₂, H₂S
B. H₂S, CO, CO₂
C. CO, H₂S, CO₂
D. CO₂, H₂S, CO
6. Which of the following substances is not built of molecules?
- A. Ice.
B. Buckminsterfullerene.
C. Potassium iodide.
D. Sucrose.
7. Sulfur has four naturally occurring isotopes, including ³³S, ³⁴S и ³⁶S. Knowing the value of $A_r(\text{S})$, which is the fourth isotope?
- A. ³²S
B. ³⁵S
C. neither.
D. There is not enough information to answer the question.
8. Metals are malleable, while ionic crystals are brittle. Which of the following statements is true?
- A. Metals are malleable since they have low melting points.
B. Ionic crystals are brittle since they have high melting points.
C. Brittleness of ionic crystals is due to the weak interaction between ions in the structure.
D. Malleability of the metals is due to the metallic bond.
9. Which of the following molecules are likely to form hydrogen bonds:
- A. PH₃
B. HI
C. CH₄
D. HNO₂
10. Which of the following trends is true?
- A. atomic radius:
 $r_{(21)\text{Sc}} > r_{(22)\text{Ti}} > r_{(23)\text{V}}$
B. ionic volume:
 $V(\text{S}^{2-}) > V(\text{Se}^{2-}) > V(\text{Te}^{2-})$
C. ionization energy:
 $E(\text{K}) < E(\text{Rb}) < E(\text{Cs})$
D. electron affinity:
 $E(\text{Fe}) > E(\text{Fe}^{2+}) > E(\text{Fe}^{3+})$



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

11. The extent of the chemical reaction is a „measure“ of the progress of the reaction. Which of the following statements is true?
- A. The ratio of stoichiometric coefficients of two participants in the chemical reaction is equal to the ratio of their chemically transformed quantities.
 - B. The value of an extent of the chemical reaction (for a specifically written chemical equation) changes depending on the participant in the chemical reaction used for calculation.
 - C. The change of the extent of the chemical reaction is difference between the extent of the chemical reaction at the beginning and at the given moment.
 - D. The fundamental SI unit for the extent of the chemical reaction is kmol.
12. The initial quantities of hydrogen and nitrogen in the reaction system, used in the course of an experiment for production of ammonia, were 3 mol and 2 mol correspondingly. After the reaction took place for some time, it was detected that the quantity of hydrogen decreased for 1 mol. The quantity of unreacted nitrogen, quantity of obtained ammonia and the change of extent of reaction (at the same time) are, correspondingly.
- A. 0.33 mol; 0.66 mol; 0.33 mol
 - B. 0.66 mol; 0.33 mol; 0.33 mol
 - C. 0.33 mol; 0.66 mol; 0.66 mol
 - D. 0.66 mol; 1.32 mol; 0.66 mol
13. Fluorine forms compounds with many elements from periodic table. Arrange the following bonds, B–F, Be–F, C–F, Li–F and O–F (which exist in the fluorine compounds) according to the degree of ionic character of chemical bonding:
- A. O–F, Be–F, B–F, C–F, Li–F
 - B. Li–F, Be–F, B–F, C–F, O–F
 - C. Li–F, Be–F, C–F, B–F, O–F
 - D. Li–F, B–F, Be–F, C–F, O–F
14. In the case of lithium iodide (LiI):
- A. the ionic character of the chemical bond is pretty higher compared with covalent character.
 - B. the covalent character of the chemical bond is pretty higher compared with ionic character.
 - C. the degrees of ionic and covalent character of the chemical bond are approximately equal.
 - D. there is not enough information to give an answer
15. A carbon nanotube can be obtained if a single graphite sheet is rolled up in an appropriate way. Does the chemical bonding remain the same as in the case of graphite?
- A. Only partly.
 - B. No, ionic bond is formed.
 - C. No, metallic bond is formed.
 - D. Yes, the chemical bonding remains the same.
16. Ammonia (NH₃) and hydrazine (N₂H₄) are both binary compounds of nitrogen and hydrogen. Based on the law of multiple proportions, the mass ratio of hydrogen that reacts with the same quantity of nitrogen, in the case of two compounds is:
- A. 3/4
 - B. 3/2
 - C. 2/3
 - D. 1/3
17. The vapor pressure of diethyl ether (C₂H₅OC₂H₅) (i.e. the pressure of vapor that is in equilibrium with the liquid diethyl ether) is greater than that of water. This is due to:
- A. the intermolecular forces, that are stronger in diethyl ether than in water
 - B. hydrogen bonding in the case of diethyl ether.
 - C. hydrogen bonding in the case of water.
 - D. hydrogen bonds in the case of water and diethyl ether.
18. Based on the Lewis structure, the following information related to the polyatomic particle can be derived:
- A. only the shape of the particle.
 - B. the chemical bond that is formed between two atoms.
 - C. a two-dimensional view of the valence electron distribution and the (polyatomic) particle shape.
 - D. no information whatsoever can be derived, since Lewis' concept is out-of-date.



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

19. The average relative atomic mass is a dimensionless physical quantity. Its value is a decimal number because the chemical element is built of:

- A. atoms with different atomic and mass numbers.
- B. nuclides with the same mass number.
- C. nuclides with the same atomic, but different mass number.
- D. isobars.

20. An amorphous substance is:

- A. diamond.
- B. limestone.
- C. glass.
- D. table salt.

21. A heterogeneous mixture is:

- A. alloy.
- B. air.
- C. brandy.
- D. milk.

22. For centuries, the Aborigines have used the leaves of the eucalyptus tree to relieve sore throats. The active ingredient is known as eucalyptol. What is its empirical formula if it is known that the analysis of a sample of eucalyptol with a mass of 3.16 g gave the following composition: 2.46 g carbon, 0.373 g hydrogen and 0.329 g oxygen?

- A. C_5H_9O
- B. $C_6H_{14}O_2$
- C. $C_{10}H_{18}O$
- D. $C_{12}H_{28}O_4$

23. The mass of a copper coin is 3.20 g. Suppose it is pure copper, how many copper atoms are present?

- A. $3.01 \cdot 10^{28}$
- B. $6.02 \cdot 10^{22}$
- C. $3.01 \cdot 10^{22}$
- D. $6.02 \cdot 10^{15}$

24. A metal M forms an oxide with the formula M_2O_3 . The mass percentage of the metal is 69.9%. What is the identity of the metal?

- A. bismuth.
- B. iron.
- C. aluminium.
- D. gold.

25. What quantity of Bi_2S_3 will be obtained if 150 mL hydrogen sulfide gas, under standard conditions, is introduced in a solution that contains 1.58 g $BiCl_3$?

- A. 2.51 mol
- B. 2.51 mmol
- C. 2.23 mol
- D. 2.23 mmol

Data that can be required:

$A_r(C) = 12.01$	$A_r(Bi) = 209.0$
$A_r(H) = 1.01$	$A_r(S) = 32.06$
$A_r(O) = 16.00$	$A_r(Cl) = 35.45$
$A_r(Cu) = 63.54$	$A_r(Au) = 197.0$
$A_r(Fe) = 55.84$	$A_r(Al) = 27.0$