CXTM	**Society of Chemists and Technologists of Macedonia** Chemistry competitions for elementary and high school students **CODE:** _____ (filled in by the jury)	FOR THE JURY ONLY Total points: _____ Checked by: _____ (Name Surname)

RULES FOR THE REGIONAL CHEMISTRY COMPETITION 2022

1) The competition **starts at 12 o'clock and lasts for 90 minutes**. The tests that are handed after the given time will not be considered for scoring.
2) The maximal score is 50 points (30 points from multiple choice questions and 20 points from the problems, as given in the test)
3) 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.
4) **No signature, or any mark is allowed on the envelope and on the test**. The code on the test, below and on the envelope, is filled in by the jury. If any signature or mark is found on the test or envelope, the competitor will be disqualified.
5) 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.**
6) 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.
7) A calculator can be used for the numerical problems.
8) 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.
9) A competitor that does not follow any of these rules/recommendations shall be eliminated from the competition.

TEST OF MULTIPLE CHOICE QUESTIONS OF WHICH ONE IS CORRECT
(Answer by circling **just one** of the options given (A), (B), (C) or (D))

Periodic table of elements with all the required information is given at the last page of this test!

1. Which of the following statements truly depicts the ionic bonding in the compound Na_2SO_4?
(A) Ionic bond is formed via electrostatic attraction between sodium ions and sulfate group anions.
(B) Ionic bond is formed between sulfur atom and the four corresponding oxygen atoms in sulfate group via sharing electrons.
(C) Ionic bond is formed between sodium ions and sulfate group anions via sharing electrons.
(D) Ionic bond is formed by electrostatic attraction between the sulfur atom and the four corresponding oxygen atoms in the sulfate group.

2. Balancing the chemical equation $C_4H_{10} + O_2 = CO_2 + H_2O$ using the least possible integer values gives a sum of the coefficients:
(A) 11
(B) 19
(C) 46
(D) none of the answers above is correct.

3. According to Heisenberg:
(A) Mass is always conserved, never lost.
(B) Same amounts of different gasses occupy the same volume under same temperature and pressure.
(C) It is impossible to determine the velocity of an electron and its position simultaneously.
(D) Electrons having the same principal, magnetic and orbital quantum number must have different spin quantum numbers.

4. It is a common practice for oil rafineries to include ethanol in gasoline blends to ensure proper combustion of non-oxygen species. Gasoline called E10 contains ethanol with mass percent of 10 %. Having in mind that the chemical formula of ethanol is CH_3CH_2OH, which of the following expressions gives the mass percent of oxygen in E10 fuel?

(A) $\frac{0{,}10 \cdot 15{,}99}{46{,}06} \cdot 100\ \%$

(B) $\frac{0{,}10 \cdot 2 \cdot 15{,}99}{46{,}06} \cdot 100\ \%$

(C) $\frac{46{,}06}{0{,}10 \cdot 2 \cdot 15{,}99} \cdot 100\ \%$

(D) None of the expressions is correct.

5. What amount of oxygen is contained in 1,50 moles of iron(III) nitrate pentahydrate?
(A) 4,50 mol
(B) 9,00 mol
(C) 13,5 mol
(D) 21,0 mol

6. The ion M in the compound MCl_3 has an electron configuration of the nobel gas neon. What is the electron configuration of the corresponding metal, M?
(A) [Ne]
(B) $[Ne]2s^2 2p^1$
(C) $[Ne]3s^2 3p^1$
(D) $[Ne]3s^2 3p^4$

7. Chose the alkaline earth metal with the highest electronegativity:
(A) Be
(B) Ba
(C) Fr
(D) F

8. Which of the following statements is incorrect?
(A) There are chemical elements whose atoms bring the same number of protons and neutrons.
(B) The number of electrons in anion is equal to its charge.
(C) Isotopes of the same element always bring the same number of protons.
(D) The ordinal number and the atomic number are the same physical quantity.

9. An oxide is:
(A) O_3
(B) CrO_3
(B) NO_2^-
(D) atomic oxygen (O)

10. Nitrogen atom is trivalent in:
(A) NO_3^-
(B) $Fe(NO_3)_3$
(C) N_2O_4
(D) N_2

11. The volume of a sample of chlorine gas under standard temperature and pressure is 1,12 dm^3. What amount of chlorine atoms is contained in this sample?
(A) 0,05 mol (B) 0,50 mol
(C) 0,10 mol (D) 1,00 mol

12. Chemical change is:
(A) green wood leaves becoming yellow.
(B) drying of wet wood leaves.
(C) crumbling of dry wood leaves.
(D) falling of wood leaves from the tree to the ground.

13. Which of the following statements is correct?
(A) The number of neutrons in $^{40}Ca^{2+}$ is 40.
(B) The number of electrons in $^{40}Ca^{2+}$ is 22.
(C) The number of neutrons in Ca^{2+} can not be determined since it is unknown for what isotope it is referred.
(D) The number of neutrons in Ca^{2+} does not depend on the fact which isotope is chosen.

14. The group of elements that are neighbours to the noble gasses group is called:
(A) group of noble metals.
(B) chalcogen group.
(C) earth-alkaline group.
(D) None of the terms given is correct.

15. Double covalent bond:
(A) is constituted of two sigma bonds.
(B) is constituted of two pi bonds.
(C) is constituted of one sigma and one pi bond.
(D) is a special case of metallic bond.

PROBLEMS:

(Write the solution of these tasks in the field provided for that purpose)

The Periodic table of the elements with all the required information is given at the last page!

1. Write the chemical formulas/names of the following compounds: (10 x 0,80 points)

- Ammonium sulfate

  $(NH_4)_2SO_4$

- Barium chlorate monohydrate

  $Ba(ClO_3)_2 \cdot H_2O$

- Tetraphosphorus hexasulfide

  P_4S_6

- Mercury(II) iodide

  HgI_2

- Boric acid

  H_3BO_3

- $Na_2S_2O_3 \cdot 5H_2O$

  Sodium thiosulphate pentahydrate

- KBr

  Potassium bromide

- $Co(H_2AsO_4)_2$

  Cobalt(II) dihydrogenarsenate

- MnO

  Manganese(II) oxide

- $Al(OH)_2NO_3$

  Aluminum dihydroxide nitrate

SEE THE SOLUTIONS IN THE MKD-VERSION OF THE TEST!

2. Aluminium and iodine react with each other giving aluminium iodide.

(A) Write and balance the chemical equation for this process using the least integer values.

(1 point)

(B) What amount of iodine is required for a yield of 0,80 mol aluminium iodide?

(1 point)

(C) Calculate the initial masses of the two reactants required to react and give 10 g aluminium iodide.

(3 points)

3. 960 mg sample of zinc with some copper impurities is added to dilute hydrochloric acid solution.
   (A) Which of the two metals reacts with the acid? Write the chemical equation for this process and balance it with the least possible integer values. (1 point)

   (B) If the volume of the gas produced in this reaction is 630 mL (determined at standard temperature and pressure), calculate the mass fraction (mass percentage) of zinc and copper in the sample. (6 points)

1 **H** 1.008																	2 **He** 4.003
3 **Li** 6.941	4 **Be** 9.012											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.31											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.07	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.88	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.39	31 **Ga** 69.72	32 **Ge** 72.61	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	57 **La** 138.9	72 **Hf** 178.5	73 **Ta** 181.0	74 **W** 183.8	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** 226.0	89 **Ac** 227.0	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (263)	107 **Bh** (262)	108 **Hs** (265)	109 **Mt** (266)	110 **Ds** (281)	111 **Uuu** (272)	112 **Uub** (285)	113 **Uut** (284)	114 **Uuq** (289)	115 **Uup** (288)			

58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0
90 **Th** 232.0	91 **Pa** 231.0	92 **U** 238.0	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (262)