1. In its ground state, the atom of a chemical element has 10 atomic orbitals in total, which are fully occupied with electrons. The atom of this chemical element will reach electronic octet if it binds with:
A. covalent bond with one atom of the chemical element $_8Y$.
B. ionic bond with one atom of the chemical element $_{17}Y$.
C. covalent bond with two atoms of the chemical element $_1Y$.
D. ionic bond with two atoms of the chemical element $_9Y$.

2. Which of the following ions has the biggest radius?
A. Na^+.
B. Al^{3+}.
C. Cl^-.
D. S^{2-}.

3. What is the number of shared and the number of lone electronic pairs in the molecule of white phosphorus P_4?
A. 4 shared electronic pairs and 3 lone electronic pairs.
B. 6 shared electronic pairs and 4 lone electronic pairs.
C. 8 shared electronic pairs and there are none unshared electronic pairs.
D. 12 shared electronic pairs and 8 lone electronic pairs.

4. Calculate the number of oxygen atoms in 9.81 g ammonium iron(II) sulfate hexahydrate.
($A_r(Fe) = 55.85$ $A_r(N) = 14.01$
$A_r(O) = 16.00$ $A_r(H) = 1.01$
$A_r(S) = 32.06$).
A. $2.11 \cdot 10^{23}$.
B. $1.51 \cdot 10^{22}$.
C. $1.81 \cdot 10^{23}$.
D. $7.23 \cdot 10^{23}$.

5. How many electrons, altogether, are there in the manganate ion?

$(^{16}_{8}O$ $^{55}_{25}Mn)$

A. 50.
B. 51.
C. 58.
D. 59.

6. In a container with constant volume of 250 mL there is 0.4 g of a gaseous substance. At certain temperatue and pressure of 200 kPa, the molar volume of the gas is 0.020 m^3/mol. What is the molar mass of the gas?
A. 80 g/mol.
B. 28 g/mol.
C. 32 g/mol.
D. 16 g/mol.

7. Which of the listed substances is an oxide?
A. KO_2.
B. GeO_2.
C. F_2O.
D. BaO_2.

8. The melting point of some unknown substance X is 857 °C. In solid state this substance X does not conduct electricity. It is soluble in water. When dissolved or melted in conducts electricity. Which of the following substances could be the described substamce X?
A. Silicon dioxide.
B. Potassium fluoride.
C. Boron nitride.
D. Sulfur.

9. What is the name of the compound with the formula $Co_2(HPO_4)_3$?
A. Cobalt(II) hydrogenphosphate.
B. Cobalt(III) hydrogenphosphate.
C. Dycobalt threehydrogenphosphite.
D. Cobalt(III) metaphosphate.

10. The ionization energies of an unknown element X are as follows:

E_{j1}=496 kJ/mol,
E_{j2}=4562 kJ/mol,
E_{j3}=6910 kJ/mol,
E_{j4}=9543 kJ/mol
How much energy is needed for ionization of 1 mol atoms of this element in its usual ions?
A. 496 kJ.
B. 5058 kJ.
C. 9047 kJ.
D. 21511 kJ.

11. Which of the following statements for the ionic bond are correct?
I. The ionic bond is formed as a result of an electrostatic attraction of ions with an opposite charge.
II. The ionic bond is not directed in space like the covalent bond.
III. The radius of the cation is smaller than the radius of the anion of the same element.
IV. In general, the cations of the elements in one period are smaller than the anions of the elements in the same period.
V. The bigger the charge of the cation, its radius is larger.
VI. The bigger the charge of the anion, its radius is smaller.
VII. Ions with a different charge are oriented and distributed one around the other in all directions.
VIII. The ions formed, cation and anion, obtain the electron configuration of the noble gas that is after them in the periodic table.
A. Only statements I, II, III, IV, and VII are correct.
B. Only statements I, II, III, and VII are correct.
C. Only statements I, II, III, IV, V, VI and VII are correct.
D. All given statements are correct.

12. X and Y are elementary substances which form ionic compound with the formula X_2Y. The ions X^+ and Y^{2-} have the same number of electrons as the atom of argon which is in the 18th group and the third period of the periodic system. Which of the listed ones is the name of the chemical compound repereseted with the formula X_2Y?
A. Sodium oxide.
B. Rubidium selenide.
C. Potassium sulfide.
D. Calcium chloride.

13. The products of the reaction between magnesium nitride and water are magnesium hydroxide and ammonia. The sum of smallest possible integer stoichiometric coefficients in the balanced equation of this reaction is:
A. 6.
B. 11.
C. 12.
D. 22.

14. In which of the reactions (represented with the equations below with the names of reactants), a salt is obtained as one of the products?
A. molybdenum(VI) oxide + hydrogen $\longrightarrow$
B. silicon dioxide + sodium hydroxide $\longrightarrow$
C. silicon tetrachloride + hydrogen $\longrightarrow$
D. copper(I) sulfide + copper(I) oxide $\longrightarrow$

15. Which of the following statements is correct?
A. The atoms in the hydrogencarbonate ion are bonded by an ionic bond.
B. In the molecule of carbon dioxide, the bonds between the carbon atom and the oxygen atoms are polar covalent bonds and therefore carbon dioxide is a polar compound.
C. Sigma (σ) bond is always formed with overlapping of orbitals along the line connecting the nuclei of the two atoms
D. The longer the covalent bond, the higher its strength.

PROBLEMS:

(Write down the solution procedure and the answer in the designated place.)

1. Write the chemical formulae or the names of the following compounds.

(8 · 0.5 = 4 pts)

HBO_2	
Cu_3N	
$Na_2S_2O_3$	
PdO_2	
Tungsten(VI) oxide	
Ammonium nitrite	
Polonium(II) sulfide	
Magnesium iodate	

2. In a reaction of vanadium(V) oxide with aluminum, vanadium and aluminum oxide are obtained.
A. Write down and balance the equation of this reaction. **(1 pt)**

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B. What is the mass of vanadium that could be obtained in a reaction of 382 mg vanadium(V) oxide and 270 mg aluminum? **(6 pts)**
(A_r(vanadium) = 50.94; A_r(aluminum) = 26.98; A_r(oxygen) = 16.00).

C. The density of aluminum metal is 2.7 g/cm^3. What is the quantity of valence electrons in 5 mm^3 aluminum? Aluminum is located in the 13th group and third period in the periodic table of the elements. **(3 pts)**

3. In a mixture composed of sodium chloride and calcium carbonate only, the mass ratio of sodium chloride was 0.4545. Then, 3.00 g of sodium chloride were added to the mixture. The mass ratio of calcium carbonate in the new mixture was 0.25.
   $(A_r(Ca) = 40.08$ $A_r(Na) = 22.99$ $A_r(O) = 16.00$
   $A_r(C) = 12.01$ $(A_r(Cl) = 35.45)$

A. Calculate the mass of the starting mixture. **(4 pts)**

B. What is the mass of calcium carbonate in the second mixture? **(2 pts)**