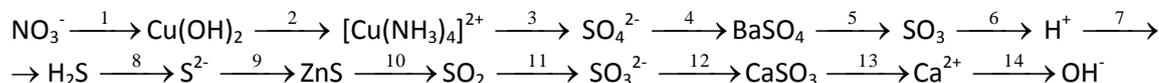


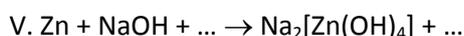
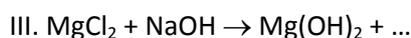
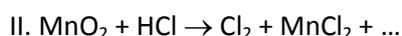
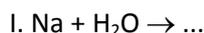
Each problem is graded from 0 to 10 points. Please write different problem solutions on different paper!

1. Write molecular equations for reactions to show how to realize such chemical transformations:



Write ionic and net ionic equations for reaction number 1.

2. One of the most common reactions in nature is oxidation-reduction reactions. Here are given five incomplete reaction equations:



- a. Complete and balance given reaction equations.
- b. Identify redox reactions! State oxidizing and reducing agent in each case.
- c. Write oxidation-reduction half reaction equations for one reaction. Use real particles in equations.
3. Metallic element **A** reacts with concentrated sulfuric acid and produces blue solution of metal **A** sulfate and gas **C**. Metallic element **B** does not react with concentrated sulfuric acid, but reacts with diluted sulfuric acid and produces gas **D**. Metal **A** does not react with diluted sulfuric acid. If metal **B** are placed in metal **A** sulfate solution metal **A** precipitate is formed. After infinite time when metal **B** sulfate is obtained solution turns to light green color. Adding of sodium hydroxide causes color change from light green to grey and then to brown.
- a. Write formulas for substances **A**, **B**, **C** and **D**!
- b. Write equations for all chemical reactions described!
- c. Show electron arrangement and configuration in metal **A** and metal **A**²⁺ ion.
4. One of the biggest problems in technique is use of natural water due to water hardness. Hardness in water is defined as the presence of multivalent cations, usually magnesium and calcium. Respective anions in solution are hydrogen carbonates, sulfates and chlorides. Hydrogen carbonates are present in water due to dolomite $\text{CaCO}_3 \cdot \text{MgCO}_3$ and calcite CaCO_3 rocks.
- a. Write ionic and net ionic equations for reactions taking place in formation of hard water when water becomes in contact with dolomite and air.
- b. The simplest way to reduce water hardness is water boiling. Write ionic and net ionic equations to show transformations occurring during boiling.
- c. Water hardness can be reduced using phosphates. Write ionic and net ionic equations to show transformations occurring after addition of sodium phosphate.
- Method for determination of water hardness is titration with etilendiaminetetraacetic acid (EDTA) solution in basic medium. At such conditions EDTA reacts with metal ions on molar ratio of 1 : 1. Calculate water hardness of Riga tap water if student of Riga State gymnasium No.1 took 50.0 mL of tap water and titrated it with solution which contains 0.00700 mol of EDTA per liter. For complete reaction he used 10.57 mL of EDTA solution.
- d. Calculate amount of ions (in moles) in tap water sample. Express ion amount as molar concentration – moles of ions per liter of tap water.

5. Photography is so common that most people never give a moment thought to how remarkable the process is. Ordinary black-and-white photographic film consists of celluloid crystals of silver(I) bromide. When exposed to light, the surfaces of the silver (I) bromide grains turn dark because of light-induced redox reaction in which bromine transfers an electron to silver. The key to every silver halide photography is the developing process with the organic reducing agent. Once the image is fully formed, the film is fixed by washing away the remaining unreduced silver(I) bromide with a solution of thiosulfate $\text{Na}_2\text{S}_2\text{O}_3$.
- Write the chemical equation, when AgBr is exposed to light!*
 - Write oxidation-reduction half reaction equations for the reaction, when AgBr is exposed to light. State oxidizing and reducing agent.*
 - Is it possible to use distilled water to wash away the remaining unreduced silver(I) bromide (State the reason)? Why does it is important to wash away the film with sodium thiosulfate $\text{Na}_2\text{S}_2\text{O}_3$ solution, explain writing corresponding reaction equation?*
 - The image produced on photographic film is negative one, with dark objects appearing light, and light objects appearing dark. Explain how this negative image is converted to a positive image when printed.*