LABORATORY WORK NO.11

REDOX REACTION I

- **PRINCIPLE:** Oxidation-reduction reactions (redox reactions) include all chemical reactions where reactants exchange electrons. The main feature of redox reactions is the change of oxidation numbers of reactants.
  We differentiate two partial reactions:
  Oxidation is a reaction where the oxidation number of particles increases, particle loses electrons.
  Reduction is a reaction where the oxidation number of particles decreases and particle receives electrons.
  At redox reactions one particle is oxidized while the other is simultaneously reduced.

$$M_1 + M_2X \rightarrow M_2 + M_1X$$

The metal M_1 displaces the metal M_2 from its solution if the metal M_2 is situated in a metal tension series to the right of metal M_1.
Beketov's metal displacement series – (incomplete):

Zn, Cr, Fe, Cd, In, Co, Ni, Sn, Pb, H, Mo, Re, Cu, Os, Ru, Ag, Hg, Pt

Metals lying to the left of hydrogen are called **non-noble metals** and those lying to the right of hydrogen are called **noble metals**.

Inorganic acids can be divided into the **oxidizing** (nitric acid HNO_3-both concentrated and diluted, sulfuric acid H_2SO_4 - concentrated) and the **non-oxidizing acids** (hydrochloric acid HCl and diluted sulfuric acid H_2SO_4).

Non-noble metals react with non-oxidizing acids under formation of hydrogen, with oxidizing acids under formation of corresponding carbon acids.
Noble metals do not react with non-oxidizing acids, oxides of the relevant acids are created with oxidizing acids.

TASK 1. MUTUAL DISPLACEMENT OF METALS FROM SOLUTIONS

- **CHEMICALS:** $MgSO_4$, $ZnSO_4$, $CuSO_4.5H_2O$ (solutions c = 0,5 mol/l), metals Mg, Zn and Cu.
- **AIDS:** test tubes, pipette

- **PROCEDURE:**

Pour 2 ml of solutions of MgSO4, ZnSO4, $CuSO4.5H_2O$ (c = 0.5 mol/l) into three test tubes. Put a piece of magnesium to each test tube and observe the course of the reaction (watch what happens on the surface of the metal). Write down the result into the table so that the + sign marks cations of salts which are reduced by magnesium and where there was a clear change.Perform this experiment also with pieces of Zn andCu.

Metal	**Mg^{2+}**	**Zn^{2+}**	**Cu^{2+}**
Mg	-		
Zn		-	
Cu			-

Example of ionic equation: Mg + Zn 2 + → Mg 2 + + Zn

- **CONCLUSION:** Complete the table and write down the equation (in ionic form) of all proceeded reactions.

TASK 2. METAL REACTION WITH OXIDIZING ACIDS

- **CHEMICALS:** HCl (1:1), concentrated HNO_3, metals Zn and Cu
- **AIDS:** test tubes, pipette

- **PROCEDURE:** Pour 2 ml of HCl into one test tube, and 2 ml of concentrated HNO3 into the second one. Throw a piece of copper into each tube and observe the reactions. Repeat the process with zinc. Write down the observation into the table.

Metal	**diluted HCl**	**concentrated HNO_3**
Zn		
Cu		

Equation:

$Zn + 2HCl \rightarrow ZnCl_2 + H_2$

$Zn + 2H^+ \rightarrow Zn^{2+} + H_2$

$Zn + 4HNO_3 \rightarrow Zn(NO_3)_2 + 2NO_2 + 2H_2O$

$Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$

- **CONCLUSION:** Fill in the table and explain reactions.
- **SAFETY RULES:** Inorganic acids belong to corrosive substances, therefore always wear protective equipment.

TASK 3. FLAME TESTS FOR CATIONS OF ALKALINE METALS AND ALKALINE EARTH METALS

- **CHEMICALS:** $LiNO_3$, NaCl, KCl, $Ca(NO_3)_2$, $CuCl_2$, $Sr(NO_3)_2$, $BaCl_2$, diluted HCl(1:1)
- **AIDS**: platinum wire, burner
- **PROCEDURE:**
  Dip the platinum wire into diluted HCl and then anneal it with non-luminous flame until the flame stops colouring. Then put the sample on the wire and bring it closer to the bottom of non-luminous flame, thereby you reach its colouring. After each test, you have to anneal the wire until it is completely clean. Write the observations down in the table.

Cation	Flame colour	Observation
Li^+	carmine red	
Na^+	yellow	
K^+	light violet	
Ca^{2+}	brick red	
Cu^{2+}	blue-green	
Sr^{2+}	purple red	
Ba^{2+}	yellow-green	

- **CONCLUSION:** Fill in the table and describe the observations.

STUDENT´S SHEET No. 11
REDOX REACTION I

1. Vocabulary:

Translate the vocabulary and learn it:

1. Redox reaction-
2. noble metals-
3. alkaline metals -
4. non-noble metals-
5. alkaline-earth metals –
6. Beketov´s tension series -
7. dilute -
8. anneal-
9. non-luminous-

2. Catch-up activity:

Write title for left and right part of the series:

Beketov's metal tension series (incomplete)

Zn, Cr, Fe, Cd, In, Co, Ni, Sn, Pb, H, Mo, Re, Cu, Os, Ru, Ag, Hg, Pt

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3. Explain shortly following terms :

(what is it and what happens during each action?)

- **Oxidation :** .....

  .....

  .....

- **Reduction:** .....

  .....

4. Gap-fill excercise

Choose correct words and fill them in the gaps:

carbon acids, do, hydrogen, HCl , H_2SO_4, noble metals, HNO_3, non-noble metals

1. Metals lying to the **left** of hydrogen are called..... and those lying to the **right** of hydrogen are called .....

2. Inorganic acids can be divided into the oxidizing (nitric acid ..... concentrated and also diluted, sulfuric acid H_2SO_4 - concentrated) and the non-oxidizing acids (hydrochloric acid ..... and sulfuric acid diluted H_2SO_4).

3. Non-noble metals react with non-oxidizing acids to form ....., with oxidizing acids to form the corresponding .....

4. Noble metals ..... not react with non-oxidizing acids. Oxides of the relevant acids are created with oxidizing acids.