



LABORATORY WORK NO. 28

CARBOXYLIC ACIDS

- **PRINCIPLE:** Carboxylic acids are substances which contain one or more carboxyle groups in their molecule. Two derivative types are derived from them: substitutional and functional.

- *Properties of carboxylic acids:*

- they are usually solid, crystallic substances
- lower acids are soluble in water
- most of the carboxylic acids belong to weak acids

- The power of carboxylic acids is influenced by hydrocarbon rests and substituents bonded in their molecules. The acid power is also increased by the presence of multiple bond or aromatic nucleus near the carboxylic group.

- **TASK N. 1 REDUCTION EFFECTS OF FORMIC ACID**

- **CHEMICALS:** concentrated formic acid HCOOH , acetic acid CH_3COOH ($c = 2\text{ mol/l}$), AgNO_3 ($c = 0,1\text{ mol/l}$), NH_3 (1:10), NaOH ($c = 2\text{ mol/l}$)

- **AIDS:** test tubes, water bath, burner, test tube holder, pipette

- **PROCEDURE:** We prepare 2 test tubes - we clean them with a solution of sodium hydroxide and wash them with a great amount of water.

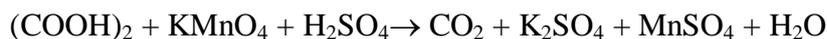
- We pour 2 ml of AgNO_3 solution (concentration of 0,1 mol/l) into both test tubes and we drop the water solution of ammoniac (1:10) until the arising sediment dissolves.
- We put 1 ml of formic acid into the first test tube, we mix the mixture and we put the test tube into the hot water bath.
- We put 1 ml of acetic acid into the second test tube and we put it into the hot water bath. We observe the changes in both test tubes.

- **CONCLUSION:** Compare the experiments' results and draw a conclusion.

- **SAFETY:** Concentrated formic acid causes skin burning and eye damage. Do not breathe its fumes and use protective gear (clothing, gloves, glasses, shield).

TASK N. 2 OXIDATION OF OXALIC ACID

- **CHEMICALS:** saturated solution of oxalic acid (COOH)₂, KMnO₄ (c=0,1mol/l), 15% solution of sulphuric acid H₂SO₄
- **AIDS:** 250 ml boiling flask, burner, stand, water bath, pipette
- **PROCEDURE:** We put 5 ml of saturated solution of oxalic acid into the boiling flask. We add 5 ml of 15% H₂SO₄. We warm up the mixture slowly in the water bath and we drop the solution of potassium manganate KMnO₄ (0,1 mol/l). We observe the change of colour.
- **CONCLUSION:** Explain the change of colour in KMnO₄, adjust the chemical equation and write the individual redox reactions.

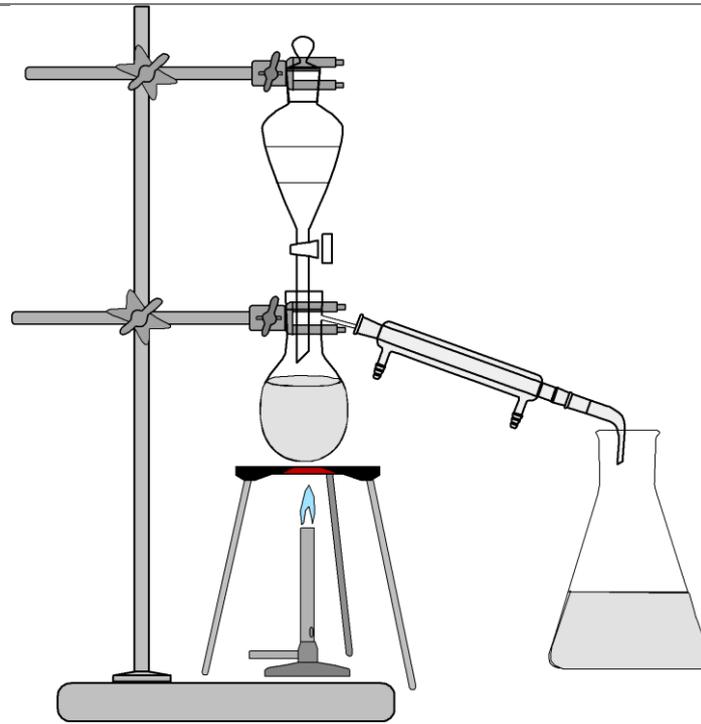


TASK N. 3 PREPARATION OF ACIDIC ACID BY OXIDIZING ETHANOL

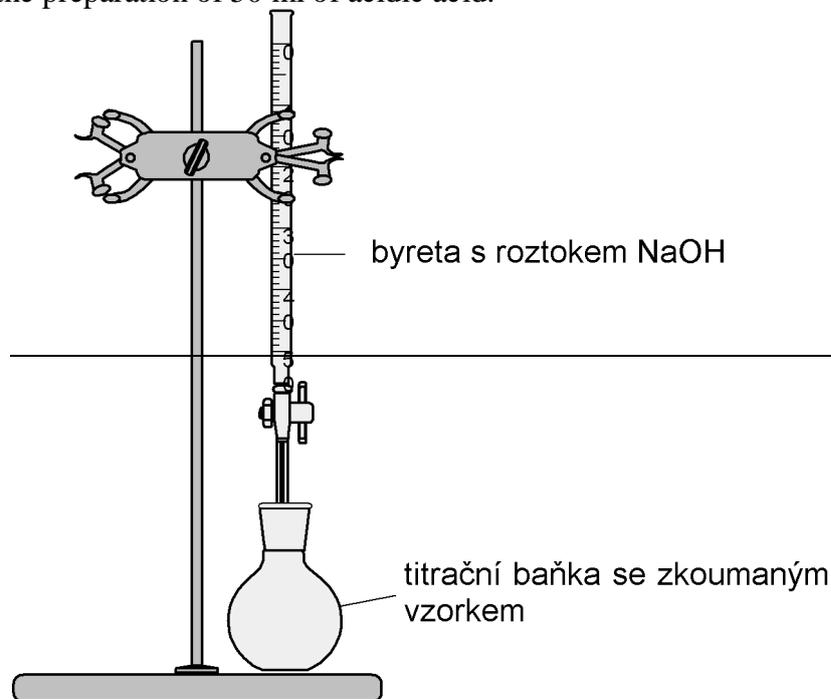
- **CHEMICAL:** 6% solution of KMnO₄, concentrated sulphuric acid H₂SO₄, ethanol, universal indicator paper
- **AIDS:** stand, burner, side-tube flask, separatory funnel, cooler, pipette, Erlenmayer flask
- **PROCEDURE:** We pour 20 ml of the solution of potassium permanganate into the side-tube flask and we acidify it with 5 ml of sulphuric acid. We pour 5 ml of ethanol into the separatory funnel. We heat up the side-tube flask to the boiling point and we drop ethanol from the separatory funnel into it. We distill and we prove the presence of acid in the arised distillate by indicator paper.

The reaction equation:





- **CONCLUSION:** Calculate the needed amount of potassium permanganate for the preparation of 20 ml of the 6% solution. Calculate how many milliliters of ethanol are needed for the preparation of 50 ml of acidic acid.



Picture: burette with NaOH solution

Titration flask with the observed sample



STUDENT'S SHEET

1. Match the Czech names with their English equivalents:

carboxylic acid	substituent
substitutional derivative	kyselina octová
crystalloid	karboxylová kyselina
substituent	kyselina mravenčí
formic acid	substituční derivát
acetic acid	krystalický
oxalic acid	kyselina šťavelová

2. Fill in the missing letters

s-tu-at-d s-l-ti-n
-x-li- a-id
sk-n bur-i-g
cr-st-l-oi-
su-st-tu-n-

3. Choose the correct word or spelling

- 1) an organic compound that contains a carboxyl group (CO_2H)
a) water b) carboxylic acid c) saturated solution
- 2) the simplest carboxylic acid
a) formic acid b) oxalic acid c) carboxylic acid
- 3) an organic compound with the chemical formula CH_3COOH
a) formic acid b) acetic acid c) oxalic acid
- 4) an atom or group of atoms substituted in place of a hydrogen atom on the parent chain of a hydrocarbon
a) solution b) substituent c) acid

4. Translate the following words into English

karboxylová kyselina
poleptání kůže
kyselina šťavelová
nasycený roztok
kyselina mravenčí
kyselina octová



5. Find the right word in the mixed letters

TENSUBSITUT
ICMFOR IDAC
XOAICL IDAC
DIERAVITVE
OSULTNO

SUBSTITUENT
FORMIC ACID
OXALIC ACID
DERIVATIVE
SOLUTION

6. Describe the process happening in the picture. PREPARATION OF ACIDIC ACID BY OXIDIZING ETHANOL

