**EXERCISE 1**

**CHEMICAL KINETICS**

**Theoretical topics**  
rate constant, reaction rate, kinetics of zero, first, and second-order reactions, temperature dependence of rate constant, Arrhenius equation, enzymatic reaction kinetics, activation energy, kinetics of consecutive reactions, activation energy constant

**Experimental Part**

**Topic:**  
Kinetics of the hydrolysis reaction.

**Objective:**  
Determination of the hydrolysis rate constant of ethyl acetate in an acidic environment.

**Apparatus:**  
water bath, 200 cm³ Erlenmeyer flask with a ground glass stopper, 50 cm³ graduated cylinder, 50 cm³ burette

**Reagents:**  
ethyl acetate, 0.2 M NaOH, 1 M HCl, phenolphthalein, distilled water

**Procedure:**

1. Add 45 ml of water and 50 ml of 1 M HCl to a 200 cm³ Erlenmeyer flask with a ground glass stopper, and close the flask with the corresponding stopper.
2. Turn on the water bath and wait until the temperature stabilizes at 60°C.
3. Place the flask in the water bath by removing the cover of one of the slots and immersing the flask in the water.
4. The flask should be heated in the water bath for 10 minutes.
5. After this time, carefully transfer the flask under a fume hood, add 5 ml of ethyl acetate using a pipette located there, and mix thoroughly.
6. Immediately after mixing, take 5 ml of the solution from the flask and transfer it to two Erlenmeyer flasks, diluting with cold distilled water to approximately 50 ml.
7. Place the flask with the remaining portion of the solution back in the water bath for 30 minutes.
8. Titrate the two previously taken samples using 0.2 M NaOH solution with phenolphthalein (3 drops). Record the volume of NaOH solution used in a table as the value at time t=0.
9. After 30 minutes, carefully remove the flask from the water bath, take two more samples of 5 ml each, dilute them to approximately 50 ml, and titrate with 0.2 M NaOH solution with phenolphthalein, following the procedure used previously. Record the volume of NaOH used in the table as the value at time t=30. **NOTE:** Do not add another portion of ethyl acetate!
10. Take further samples after 45, 60, 75, and 90 minutes from the time of ester addition, following the same procedure as above, and record the volumes of NaOH used for titration in the table.
11. The final titration should be performed after approximately 7 days (during the next session), as by that time, the entire amount of ester will have undergone hydrolysis. To do this, transfer the remaining solution to an additional container according to the instructor's instructions and titrate it in the following week using the same procedure as before.
12. Use the average values of the two measurements as data for the calculations.

**Report**

1. Summarize the measurement results in Table 1.
2. Calculate the rate constant values in Table 2.
3. Calculate the average reaction rate values in Table 3.
4. Plot a graph showing the dependence of the average reaction rate on time.
5. Provide conclusions for the performed experiment.