

LABORATORY WORK NO. 8

RATE OF CHEMICAL REACTION

- **PRINCIP:** Chemical kinetics studies the rate (speed) of chemical reactions and deals with the factors that affect this rate. The rate of chemical reactions means either decrease of amount of the substance of starting material or increase of amount of the substance of the product per time unit. The rate of chemical reaction is influenced by many factors.

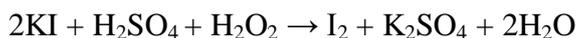
The most important factors are:

- a) Concentration of the reactants
- b) Temperature of the reaction mixture
- c) Surface of the reactants
- d) Influence of the catalysts

TASK NO.1 THE RATE OF THE CHEMICAL REACTION – DEPENDENCE ON THE CONCENTRATION OF REACTANTS

- **CHEMICALS:** KI $c = 0,01 \text{ mol/l}$, 3% H_2O_2 solution, H_2SO_4 $c = 0,01 \text{ mol/l}$, starch paste
- **AIDS:** graduated cylinder, pipettes, stirring rod, stopwatch
- **PROCEDURE:**
 1. Pour 10 ml of H_2SO_4 solution in concentration of 0.01 mol/l and 5 ml of starch paste into the graduated cylinder with a volume of 50 ml.
 2. Using the pipette, add 20 ml of KI solution in concentration of 0.01 mol/l. Add water so that in the cylinder there is 40 ml of solution in total, stir it by the stirring rod, then pour 10 ml of 3% H_2O_2 solution and stir again.
 3. Measure the time in which the prepared solution turns blue.
 4. Do the same for three more times with the difference that, instead of 20 ml of KI solution, pipette 10, 5 and 1 ml of KI solution. (It is always necessary to fill in the solution with water to the volume of 40 ml).

The reaction is based on the oxidation of iodide to iodine by acting of hydrogen peroxide in the acidic environment. The resulting iodine turns the starch paste blue.



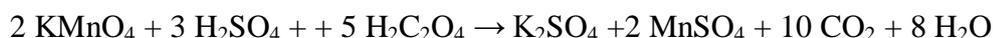
- **CONCLUSION:** Write down the results of the measurement into the table and explain the dependence of the chemical reaction rate on the concentration of the reactants.

Solution KI (ml)	1	5	10	20
Time (s)				

TASK NO. 2 THE RATE OF THE CHEMICAL REACTION - DEPENDENCE ON TEMPERATURE

- **CHEMICALS:** oxalic acid $c = 0,05 \text{ mol/l}$, H_2SO_4 $c = 1 \text{ mol/l}$, H_2O , KMnO_4 $c = 0,02 \text{ mol/l}$
- **AIDS:** 3 Erlenmayer flasks 100 ml, water bath, stopwatch, pipette, ice, thermometer
- **PROCEDURE:**
 1. Pour 10 ml of oxalic acid in concentration of 0.05 mol/l and add 25 ml of H_2SO_4 in concentration of 1 mol/l into each of the three 100 ml Erlenmayer flasks.
 2. Heat the first flask in water bath to 80°C , the second one to 50°C and cool down the third one to 10°C in ice water. Then add to all of them 5 ml of KMnO_4 solution in concentration of 0.02 mol/l and stir them.
 3. Measure the time in which the solution in each flask discolours.

Potassium permanganate reacts in an acidic environment (H_2SO_4) with oxalic acid $\text{H}_2\text{C}_2\text{O}_4$ according to this equation:



- **CONCLUSION:** Write down the results of the measurement into the table and explain the dependence of the rate of the chemical reaction on the temperature of the reactants.

Temperature ($^\circ\text{C}$)	80	50	10
Time (s)			

TASK NO. 3 HOW THE REACTANT SURFACE INFLUENCES THE RATE OF THE CHEMICAL REACTION

- **CHEMICALS :** H_2SO_4 $c = 1 \text{ mol/l}$, Zn - powdery, Zn – granulated
- **AIDS:** test tubes, tea spoon
- **PROCEDURE:** Pour 3 ml of H_2SO_4 into the first tube and add one granule of Zn. Pour equal amount of H_2SO_4 into the second tube and add a small amount of powdered zinc.
- **CONCLUSION:** Write down the equation how Zn reacts with H_2SO_4 and explain the dependence of the rate of the chemical reaction on the surface of the reactants.



TASK NO. 4 HOW CATALYSTS INFLUENCE THE RATE OF THE CHEMICAL REACTION

- **CHEMICALS:** solid $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, Al-foil, solid NaCl
- **AIDS:** beakers, stirring rod, tea spoon
- **PROCEDURE:** We prepare 50 ml of saturated solution of copper sulfate. We add pieces of aluminum foil into the solution and we observe the chemical reaction. If the reaction proceeds slowly or not at all, we add 1 teaspoon of NaCl into the solution.

NaCl acts as a catalyst and the reaction starts to proceed.

- **CONCLUSION:** Write down the chemical equation for the reaction and explain the influence of the catalyst on the rate of the chemical reaction.



STUDENT' S SHEET No.8
RATE OF CHEMICAL REACTION

1. VOCABULARY**Match the Czech names with their English equivalents:**

stopwatch	nasycený roztok	1....
water bath	katalyzátor	2....
surface	rychlost	3....
amount of substance	vliv	4....
saturated solution	stopky	5....
oxalic	vodní lázeň	6....
effect	bezbarvý	7....
catalyst	povrch	8....
colourless	látkové množství	9....
rate	šťavelová	10....

2. Choose the correct word or spelling

- a) To pour something into
- a graduated cylindre
 - a greduated cylindre
 - a graduated cylinder
- b) The dark violet solution is
- Potassium permanganate
 - Potassum permanganate
 - Potassium permanganat
- c) that reaction can be written down as an
- ecquation
 - ewuation
 - equation
 - ecuation
- d) Reaction of potassium permanganate takes place in an:
- neutral environment
 - acidic environment
 - basic environment
 - alkali environment



3. Fill in the missing letters

- a) sto-wa-ch
- b) the-m-m-t- r
- c) ca-a-yst
- d) s-tur-ted s-l-ti-n
- e) ch-mic-l r-a-tio- r-te

4. Which factors does the chemical reaction rate depend on? Name them.

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5. Explain the effect of heating and cooling reactants. Give an example of temperatures used.

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6. Put the text and sentences into the right order:

1. reaction /slowly/ If/ the/ proceeds // the /add/ teaspoon/ to/ solution /1/ of NaCl.
2. add /We/ of/ pieces/ foil/ aluminum/ and /a/ observe/ reaction/ chemical.
3. 50 /of/ a/ We/ solution/ prepare /copper/ ml/ saturated/ of/ sulfate.