

PRE-LAB EXERCISE

Please finish the following exercises before conducting the experiment and bring the answers to the lab section. These exercises consist of 5 questions and are worth a total of 100 points, counted as 3 points of the final grade. These pre-lab exercises cover contents of the both parts of Experiment 4. Please study the corresponding lab manual carefully before doing these exercises.

Question 1 (20 points)

Please explain briefly why changing the following four factors influences the reaction rate in your own words. One sentence for each factor including only the main idea is enough.

- a) Increasing the concentration of reactants. (5 pts)

- b) Increasing the surface area of the reactants. (5 pts)

- c) Raising the temperature. (5 pts)

- d) Adding a catalyst. (5 pts)

Question 2 (10 points)

A living cell must accomplish many complicated chemical tasks. Our bodies contain countless enzymes that are used to speed up otherwise slow reactions. Knowing that enzymes are a type of catalyst, which of the following factors are affected by the presence of an enzyme: (a) the energy of the reactants, (b) the energy of the products, (c) the energy of the transition state, (d) the likelihood of a collision with the correct orientation, or (e) the temperature of the reaction.

Please first list all the correct answers (2 pts), then give brief explanations how they are affected (8 pts).

Question 3 (15 points)

Please distinguish among the following terms: initial rate, average rate, and instantaneous rate.

- Which of these rates would you expect to have the largest value? Briefly explain. (6 pts)
- Which of the rates are typically used to determine the rate law for a reaction? No need to explain. (3 pts)
- Which of these rates will we use to determine the rate law in this experiment? Briefly explain in your own words why we can use this rate. (6 pts)

Question 4 (25 points)

The following rate data were collected for the reaction: $2A(g) + 2B(g) + C(g) \rightarrow 3G(g) + 4F(g)$

| Experiment | Initial concentration / ($\text{mmol} \cdot \text{L}^{-1}$) | | | Initial rate / ($\text{mmol G} \cdot \text{L}^{-1} \cdot \text{s}^{-1}$) |
|------------|---|-------|------|---|
| | A | B | C | |
| 1 | 10. | 100. | 700. | 2.0 |
| 2 | 20. | 100. | 300. | 4.0 |
| 3 | 20. | 200. | 200. | 16 |
| 4 | 10. | 100. | 400. | 2.0 |
| 5 | 4.62 | 0.177 | 12.4 | ? |

Please answer the following questions with detailed process.

- What is the order for each reactant and the overall order of the reaction? (10 pts)
- Write the rate law for the reaction. (5 pts)
- Determine the reaction rate constant. (5 pts)
- Predict the initial rate for Experiment 5. (5 pts)

Question 5 (15 points)

- a) Assuming that concentrations are expressed in moles per liter and time in seconds, what is the unit of the rate constant, k , for an overall first order rate law? Show the detailed process. (5 pts)
- b) What is the unit of k for an overall second order rate law? Show the detailed process. (5 pts)
- c) Using these two rate constants as examples, write a general rule to explain how the units of the rate constant depends on the overall order of the rate law. (5 pts)

Question 6 (15 points)

Read through the experimental procedures carefully and answer the following questions.

- a) What should you do if you accidentally get 6M HCl onto your skin? What about H_2O_2 ? (5 points)
- b) Assume you have prepared samples for E4-2. Describe briefly how to measure the reaction time between iodine and acetone. What to observe, what apparatus to use and how do you operate? (10 points)