

SI Chemistry - Full Discipline Demo

Digital Reaction Order and Rate Laws

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI Chemistry - Full Discipline Demo
Course	SI Chemistry - Full Discipline Demo
Instructor	Sales SI Demo

Test Your Knowledge

Match each term with the best description.

⌘ Chemical kinetics

⌘ Dependent Rate of Reaction

⌘ Independent Rate of Reaction

⌘ Rate law

⌘ Reaction order

⌘ Reaction rate

↓

The study of how quickly chemical reactions occur, and the factors that affect this speed.	1
A measure of the change in reactant (or product) concentration per unit of time.	2
The relationship between the amount of reactant consumed and time if curvilinear.	3
The sum of exponents in a rate law equation.	4
The relationship between the amount of reactant consumed and time is linear.	5
An expression of the dependence of the reaction rate upon reactant concentrations.	6

Correct answers:

- 1 Chemical kinetics 2 Reaction rate 3 Dependent Rate of Reaction
4 Reaction order 5 Independent Rate of Reaction 6 Rate law

Categorize the descriptions as zero, first, or second order.

⚡ Reactants appear in the rate law as the concentration of the reactant squared.		
⚡		
The rate is independent of the reactant's concentration and that reactant does not appear in the rate law.		
⚡		
The reactant will have an exponent of 1. Increasing the concentration of a reactant increases the rate and decreasing the concentration of a reactant decreases the rate.		
—		
Zero Order	First Order	Second Order
1	2	3

Correct answers:

1

The rate is independent of the reactant's concentration and that reactant does not appear in the rate law.

2

The reactant will have an exponent of 1. Increasing the concentration of a reactant increases the rate and decreasing the concentration of a reactant decreases the rate.

3

Reactants appear in the rate law as the concentration of the reactant squared.

Exploration

Reaction rate is the measure of the change in reactant concentration per unit of time.

☒ True

☐ False



Reaction rates may be almost instantaneous or may be billions of year long.

- ☒ True ✓
- ☐ False

A ____ graph is representative of a dependent reaction rate, whereas a ____ graph is indicative of an independent reaction rate.

- ☐ linear; curvilinear
- ☒ curvilinear; linear ✓

A first order reactant has an exponent of ____.

- ☒ 1 ✓
- ☐ 2
- ☐ 3
- ☐ 4

Exercise 1

Determine the order of the IKI in this reaction.

0 / 10000 Word Limit

Determine the order of the H_2O_2 in this reaction. (Hint: Be sure to convert the concentration of hydrogen peroxide to molarity.)

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Calculate the rate law constant. (Hint: Be sure to convert the concentration of hydrogen peroxide to molarity.)

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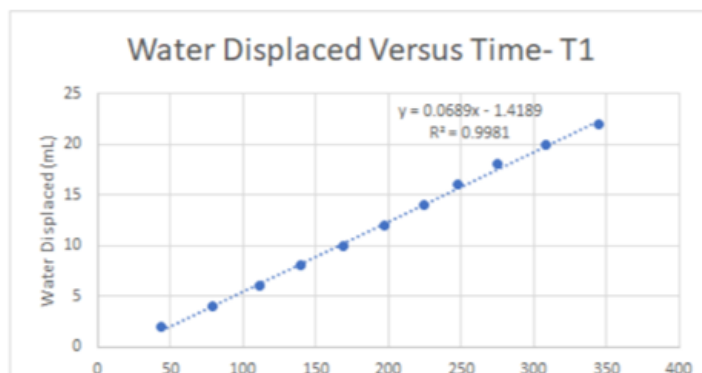
What is the overall rate law?

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Data Table 1: Trial 1 Results
(SAMPLE ANSWER BELOW)

mL Water Displaced	Time (s)
2	44
4	79
6	111
8	140
10	169
12	197
14	225
16	248
18	275
20	308

Photo 1: Trial 1 Graph
(SAMPLE ANSWER BELOW)

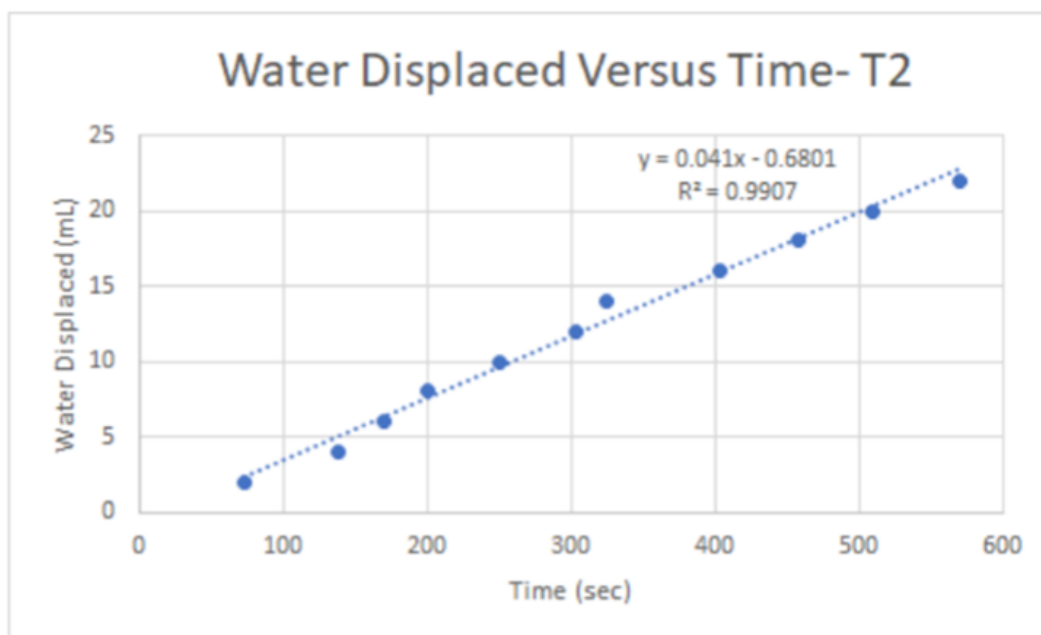


Time (sec)

Data Table 2: Trial 2 Results
(SAMPLE ANSWER BELOW)

mL Water Displaced	Time (s)
2	73
4	139
6	170
8	200
10	250
12	303
14	325
16	404
18	458

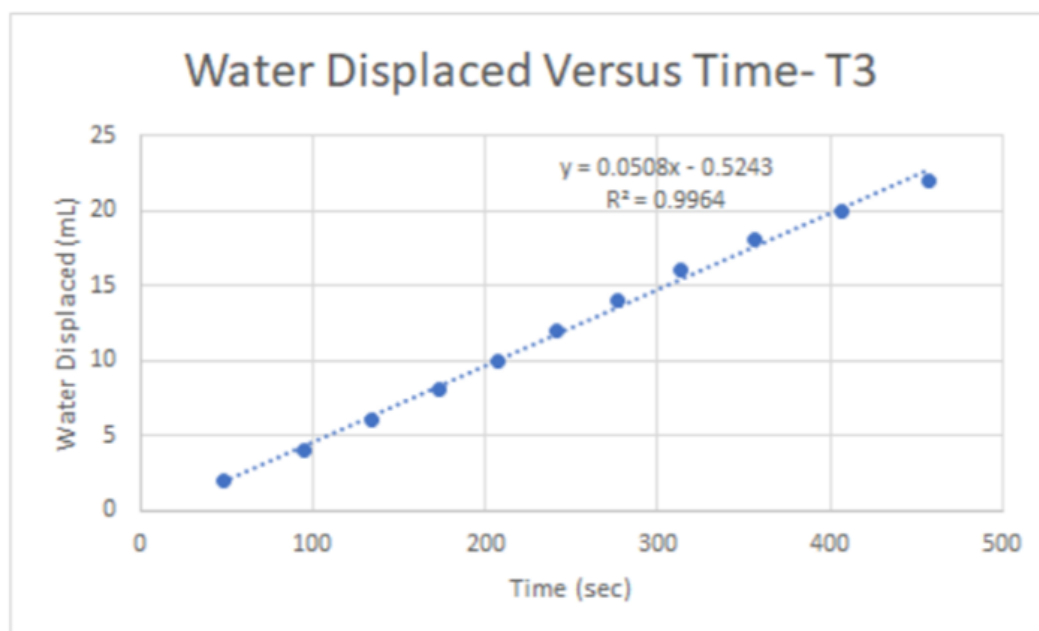
Photo 2: Trial 2 Graph
(SAMPLE ANSWER BELOW)



Data Table 3: Trial 3 Results
(SAMPLE ANSWER BELOW)

mL Water Displaced	Time (s)
2	48
4	95
6	134
8	173
10	208
12	242
14	277
16	314
18	356
20	407

Photo 3: Trial 3 Graph
(SAMPLE ANSWER BELOW)



Data Table 4: Reaction Rate Summary
(SAMPLE ANSWER BELOW)

Trial	Initial Concentration H ₂ O ₂ (%)	Initial Concentration IKI (M)	Rate
Trial 1	3%	0.6	0.069
Trial 2	3%	0.3	0.041
Trial 3	2.25%	0.6	0.051

Competency Review

Reaction rates may be ____ on the concentration of a reactant.

- ☐ dependent
- ☐ independent
- ☒ dependent or independent

✓

The rate constant and the exponents of the rate law equation can be determined merely by looking at a balanced chemical equation.

- ☐ True
- ☒ False

✓

Determining the reaction rate of a chemical reaction is useful for the development of drugs and the manufacturing of chemicals.

- ☒ True
- ☐ False

✓

The speed of a chemical reaction is called ____.

- ☐ chemical kinetics
- ☒ the reaction rate
- ☐ the reaction order

Reactants that are ____ will appear in the rate law as the concentration of the reactant squared.

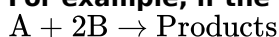
- ☐ zero order
- ☐ first order
- ☒ second order
- ☐ fourth order

Extension Questions

In the lab activity, the reaction rate was determined by the appearance of a product. However, the reaction rate can also be determined by the disappearance of a reactant.

$$\text{Rate} = \frac{\Delta[\text{Product}]}{\Delta t} \text{ or } \text{Rate} = \frac{-\Delta[\text{Reactant}]}{\Delta t}$$

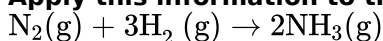
In each situation below, you are given a rate measured by the appearance of one component of the reaction and are asked to predict the rate of appearance or disappearance of another component, based on logic and stoichiometric relationships. For example, if the reaction is as follows:



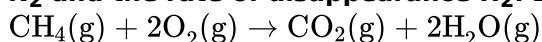
For every mole of A that is used, 2 moles of B are used so the rate of disappearance of B is twice the rate of the disappearance of A. This may be expressed as:

$$\text{Rate} = \frac{-\Delta[\text{B}]}{\Delta t} = \frac{-2[\text{A}]}{\Delta t}$$

Apply this information to the following scenarios:



The reaction rate is measured as 0.032 M NH₃/s. Determine the rate of disappearance of N₂ and the rate of disappearance H₂. Explain how you arrived at your answers.



The reaction rate is measured as -2.6 M CH₄/s. Determine the rate of appearance of CO₂ and the rate of appearance of H₂O. Explain how you arrived at your answers.

(SAMPLE ANSWER BELOW)

One mole of N₂ is used for every 2 moles of ammonia that appear, making the rate of disappearance of nitrogen half the rate of appearance of ammonia. Rate = 0.016M N₂/s. Three moles of hydrogen are used for every 2 moles of ammonia that appear, which makes the rate of disappearance of hydrogen 3/2 the rate of appearance of ammonia. Rate = 0.048 M H₂/s
One mole of carbon dioxide is produced for every mole of methane that is used. Rate = 2.6 M CO₂/s. Two moles of water are produced for every mole of methane that is used. Rate = 5.2 M

H₂O/s.