Northern Tutoring™

FREE SAMPLE

more worksheets
with solutions

CHEMISTRY WORKSHEET

# RATE LAW

Course: SCH4U Grade 12 Chemistry

**DOWNLOAD FULL WORKSHEET**

## 50 Practice Problems with Answers and Detailed Solutions

**FULL** worksheet contains 50 representative problems on:

✓ reaction order from rate laws, ✓ units of rate constants, ✓ rate-change factors, rate calculations, ✓ k calculations, initial-rate tables, ✓ pseudo-first-order conditions, ✓ elementary-step rate laws

All problems are designed to reflect style and difficulty commonly seen on quizzes, tests, and final exams. Detailed solutions are included to help students understand the reasoning behind every step.

**PART A - FUNDAMENTAL PROBLEMS**
Problems 1-15. Simple calculations and basic applications

**PART B - INTERMEDIATE PROBLEMS**
Problems 16-30. Typical unit test questions involving multiple steps

**PART C - ADVANCED PROBLEMS**
Problems 31-40. More challenging calculations requiring deeper understanding

**PART D - CHALLENGE PROBLEMS**
Problems 41-50. Difficult exam-style questions combining multiple concepts

SUITABLE FOR:
quizzes, unit tests and final exam preparation

# Section 1. Essential Summary

**DOWNLOAD FULL WORKSHEET**

# Section 2. Practice Problems

## Part A. Fundamental Skills

### Problem 8

A first-order reaction has an initial rate of 0.00480 mol/(L·s) when [A] = 0.240 mol/L. Calculate k

Rate law: rate = k[A]

## Part B. Intermediate Initial-Rate Problems

### Problem 16

Use the initial-rate data to determine the rate law, the overall order, and k

| Experiment | [A] mol/L | [B] mol/L | Initial rate mol/(L·s) |
|---|---|---|---|
| 1 | 0.100 | 0.100 | $2.50 \times 10^{-4}$ |
| 2 | 0.200 | 0.100 | $5.00 \times 10^{-4}$ |
| 3 | 0.100 | 0.200 | $1.00 \times 10^{-3}$ |

## Part C. Advanced Rate-Law Applications

### Problem 32

Use the initial-rate data to determine the rate law and k

| Experiment | [A] mol/L | [B] mol/L | [C] mol/L | Initial rate mol/(L·s) |
|---|---|---|---|---|
| 1 | 0.100 | 0.100 | 0.100 | $2.00 \times 10^{-4}$ |
| 2 | 0.200 | 0.100 | 0.100 | $4.00 \times 10^{-4}$ |
| 3 | 0.100 | 0.200 | 0.100 | $8.00 \times 10^{-4}$ |
| 4 | 0.100 | 0.100 | 0.300 | $2.00 \times 10^{-4}$ |

**DOWNLOAD FULL WORKSHEET**

## Part D. Challenge Problems

**Problem 45**

A reaction has the true rate law rate = $k[A][B]^n$. Under pseudo-first-order conditions, the observed constant is $k' = k[B]^n$. When [B] is 0.100 mol/L, $k'$ = 0.0300 1/s. When [B] is 0.300 mol/L, $k'$ = 0.0900 1/s. Determine n and k

**DOWNLOAD FULL WORKSHEET**

# Section 3. Solutions

## Part A. Fundamental Skills

**Problem 8 Solution**

**Given:** rate = 0.00480 mol/(L·s), [A] = 0.240 mol/L, first order

**Find:** k

rate = k[A]

k = rate/[A] = 0.00480/0.240 = 0.0200 1/s

**Final answer:** k = $2.00 \times 10^{-2}$ 1/s

## Part B. Intermediate Initial-Rate Problems

**Problem 16 Solution**

**Given:** initial-rate data for A and B

**Find:** orders in A and B, overall order, and k

Compare experiments where only one concentration changes. From experiments 1 and 2, [A] doubles while [B] is constant, and the rate doubles. Therefore A is first order

From experiments 1 and 3, [B] doubles while [A] is constant, and the rate increases from $2.50 \times 10^{-4}$ to $1.00 \times 10^{-3}$, which is a factor of 4. Since $2^2 = 4$, B is second order

rate = $k[A][B]^2$

$k = \text{rate}/([A][B]^2) = (2.50 \times 10^{-4})/((0.100)(0.100)^2) = 0.250\ L^2/(mol^2 \cdot s)$

**Final answer:** rate = $k[A][B]^2$; overall order = 3; k = $0.250\ L^2/(mol^2 \cdot s)$

[DOWNLOAD FULL WORKSHEET]

## Part C. Advanced Rate-Law Applications

**Problem 32 Solution**

**Given:** initial-rate data for A, B, and C

**Find:** rate law and k

Compare experiments 1 and 2 to isolate A. [A] doubles and the rate doubles, so A is first order

Compare experiments 1 and 3 to isolate B. [B] doubles and the rate increases by a factor of 4, so B is second order. Compare experiments 1 and 4 to isolate C. [C] triples and the rate is unchanged, so C is zero order

rate = $k[A][B]^2$

$k = (2.00 \times 10^{-4})/((0.100)(0.100)^2) = 0.200\ L^2/(mol^2 \cdot s)$

**Final answer:** rate = $k[A][B]^2$; C is zero order; $k = 0.200\ L^2/(mol^2 \cdot s)$

## Part D. Challenge Problems

**Problem 45 Solution**

**Given:** k′ changes from 0.0300 1/s to 0.0900 1/s when [B] changes from 0.100 mol/L to 0.300 mol/L

**Find:** order n in B and true k

Because $k' = k[B]^n$, k′ changes with [B] in the same order pattern as the rate would

[B] triples and k′ triples. Therefore n = 1

$k' = k[B]$

$k = k'/[B] = 0.0300/0.100 = 0.300\ L/(mol \cdot s)$

**Final answer:** n = 1 and $k = 0.300\ L/(mol \cdot s)$

DOWNLOAD FULL WORKSHEET

## Section 4. Answer Key

| Problem | Answer |
|---|---|
| 8 | $2.00 \times 10^{-2}$ 1/s |
| 16 | rate = $k[A][B]^2$; overall order = 3; k = 0.250 $L^2/(mol^2 \cdot s)$ |
| 32 | rate = $k[A][B]^2$; C is zero order; k = 0.200 $L^2/(mol^2 \cdot s)$ |
| 45 | n = 1; k = 0.300 $L/(mol \cdot s)$ |

**DOWNLOAD FULL WORKSHEET**