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CHEMISTRY WORKSHEET

MIXED KINETICS PROBLEMS

Course: SCH4U Grade 12 Chemistry

DOWNLOAD FULL WORKSHEET

50 Practice Problems with Answers and Detailed Solutions

FULL worksheet contains 50 representative problems on:

✓ rate law, ✓integrated rate law, ✓reaction mechanisms, ✓rate limiting step, ✓ rate orders, ✓ half-life

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

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Section 1. Essential Information

This page includes only the formulas and habits needed to solve calorimetry problems efficiently.

Formula	Use
$q = m \times \Delta T$	Heat gained or lost by a substance
$\Delta T = T_f - T_i$	Temperature change with sign
$q_{cal} = C_{cal} \Delta T$	Heat absorbed by a calorimeter
$q_{reaction} = -q_{surroundings}$	Sign convention for coffee-cup and bomb calorimetry
$q_{hot} + q_{cold} = 0$	Heat exchange between substances
$\Delta H = q_{reaction}/n$	Molar enthalpy at constant pressure

Important definitions coffee-cup calorimetry is usually constant pressure so q_p can be used for ΔH. Bomb calorimetry is constant volume, so the result is commonly treated as ΔU for SCH4U-style calculations.

Fast method identify what gains heat, identify what loses heat, convert volumes to masses when density is given, calculate ΔT carefully, include C_{cal} when provided, then apply the sign convention at the end.

Important notes for dilute aqueous solutions, use density = 1.00 g/mL and $c = 4.184$ J/(g·°C) only when stated or clearly assumed. For reactions, the solution and calorimeter are surroundings, while the chemical reaction is the system.

Common mistakes using only one solution volume after mixing, forgetting that $q_{reaction}$ has the opposite sign of q_{water}, ignoring the limiting reagent, mixing J and kJ, and using the sample mass instead of moles when a molar answer is requested.

Section 2. Practice Problems

Part A - Foundations of Reaction Rates and Rate Laws

Problem 8

A zero-order reaction has $[A]_0$ = 0.600 mol/L and k = 0.0120 mol/(L·min). Calculate [A] after 20.0 min

Part B - Initial Rates and Integrated Rate Laws

Problem 16

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

Experiment	[A] (mol/L)	[B] (mol/L)	Initial rate (mol/(L·s))
1	0.100	0.100	1.20×10^{-4}
2	0.200	0.100	2.40×10^{-4}
3	0.100	0.200	4.80×10^{-4}

Part C - Data Analysis, Mechanisms, and Arrhenius Equation

Problem 32

A reaction is first order in A. [A] decreases from 0.800 mol/L to 0.500 mol/L in 47.0 s. Calculate k, the half-life, and [A] after 100 s

Part D - Mixed Challenge Problems

Problem 45

A proposed mechanism is shown below. Determine the overall reaction, identify the intermediate, and state the rate law predicted by the mechanism

A + B → C slow

C + B → D fast

Section 3. Solutions

Problem 8 Solution

Given: zero order, $[A]_0$ = 0.600 mol/L, k = 0.0120 mol/(L·min), t = 20.0 min

Find: $[A]_t$

$[A]_t = [A]_0 - kt$

$[A]_t = 0.600 - (0.0120)(20.0) = 0.360$ mol/L

Final answer: 0.360 mol/L

Problem 16 Solution

Given: Initial-rate table

Find: Rate law and k

Compare experiments where only one concentration changes

Experiment 1 to 2: [A] doubles and rate doubles, so order in A is 1. Experiment 1 to 3: [B] doubles and rate quadruples, so order in B is 2. rate = $k[A][B]^2$. $k = (1.20 \times 10^{-4})/((0.100)(0.100)^2) = 0.120$ $L^2/(mol^2 \cdot s)$

Final answer: rate = $k[A][B]^2$; k = 0.120 $L^2/(mol^2 \cdot s)$

Problem 32 Solution

Given: first order, $[A]_0$ = 0.800 mol/L, $[A]_t$ = 0.500 mol/L at t = 47.0 s

Find: k, $t_{1/2}$, and [A] at 100 s

$\ln([A]_t/[A]_0) = -kt$; $t_{1/2} = 0.693/k$; $[A]_t = [A]_0 e^{-kt}$

$k = -\ln(0.500/0.800)/47.0 = 0.0100$ 1/s. $t_{1/2} = 0.693/0.0100 = 69.3$ s.

$[A]_{100} = 0.800e^{-(0.0100)(100)} = 0.294$ mol/L

Final answer: k = 0.0100 1/s; $t_{1/2}$ = 69.3 s; [A] after 100 s = 0.294 mol/L

Problem 45 Solution

Given: Step 1: A + B → C slow; Step 2: C + B → D fast

Find: Overall reaction, intermediate, and predicted rate law

Add the steps and cancel species produced and later consumed

C is produced in the first step and consumed in the second step, so C is an intermediate. Adding steps gives A + 2B → D. The slow step contains A and B, so rate = k[A][B]

Final answer: Overall: A + 2B → D; intermediate: C; rate = k[A][B]

Section 4. Answer Key

Problem	Answer	Problem	Answer
8	0.360 mol/L	32	k = 0.0100 1/s; $t_{1/2}$ = 69.3 s; [A] = 0.294 mol/L
16	rate = k[A][B]^2; k = 0.120 L^2/(mol^2·s)	45	Overall: A + 2B → D; intermediate C; rate = k[A][B]