



more worksheets
with solutions

CHEMISTRY WORKSHEET

EQUILIBRIUM CONSTANT

Course: SCH4U Grade 12 Chemistry

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50 Practice Problems with Answers and Detailed Solutions

FULL worksheet contains 50 representative problems on:

✓ Writing K_c expressions, ✓ Homogeneous equilibrium, ✓ Heterogeneous equilibrium, ✓ Calculating ✓ K_c from equilibrium concentrations, ✓ Calculating K_c from moles in a container, ✓ Reaction quotient (Q), ✓ Predicting equilibrium shifts, ✓ Manipulating K_c (reversing, scaling, adding equations), ✓ K_p and K_c conversions, ✓ ICE tables, ✓ Quadratic equilibrium problems, ✓ Percent dissociation problems

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
$q = m \cdot \Delta T$	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
$q_{sys} = -q_{surrounds}$	Sign convention for coffee-cup and bomb calorimetry
$q_{cal} + q_{sys} = 0$	Heat exchange between substances
$\Delta H = q_{surrounds}$	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 ICNMB-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 $c = 4.184 \text{ J/g } ^\circ\text{C}$ only when stated or clearly assumed. For reactions, the solution and calorimeter are surroundings, while the chemical reaction is the system.

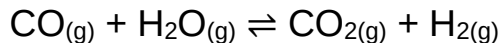
Common mistakes: using only one solution volume after mixing, forgetting that q_{sys} has the opposite sign of $q_{surrounds}$, ignoring the limiting reagent, mixing Δ and Δ_f , and using the sample mass instead of moles when a molar amount is requested.

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Section 2. Practice Problems

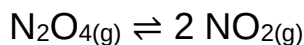
Part A - K_c expressions and direct equilibrium calculations

Problem 8. At equilibrium, [CO₂] = 0.240 M, [H₂] = 0.240 M, [CO] = 0.0800 M, and [H₂O] = 0.120 M. Calculate K_c



Part B - Manipulating K and using Q

Problem 16. For the equilibrium below, K_c = 0.212. Calculate K_c for the reverse reaction



Part C - ICE tables and equilibrium concentrations

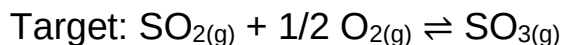
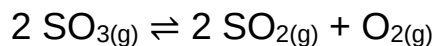
Problem 32. Initially, [PCl₅] = 0.500 M. At equilibrium, [Cl₂] = 0.200 M. Calculate K_c



Part D - Challenge equilibrium constant problems

Problem 45. For the first equilibrium, K_c = 3.20 × 10⁻².

Calculate K_c for the target reaction

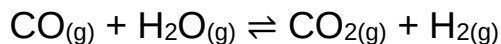


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Section 3. Solutions

Problem 8 Solution

Given: $[\text{CO}_2] = 0.240 \text{ M}$, $[\text{H}_2] = 0.240 \text{ M}$, $[\text{CO}] = 0.0800 \text{ M}$, and $[\text{H}_2\text{O}] = 0.120 \text{ M}$



Find: K_c

All coefficients are 1, so no concentration is raised to a power greater than 1

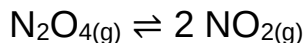
$$K_c = ([\text{CO}_2][\text{H}_2]) / ([\text{CO}][\text{H}_2\text{O}])$$

$$K_c = (0.240)(0.240) / ((0.0800)(0.120)) = 0.0576 / 0.00960 = 6.00$$

Final answer: $K_c = 6.00$. Reported to 3 significant figures

Problem 16 Solution

Given: $K_c = 0.212$ for the forward reaction



Find: K_c for the reverse reaction

Reversing a reaction takes the reciprocal of K_c

$$K_c(\text{reverse}) = 1 / K_c(\text{forward})$$

$$K_c(\text{reverse}) = 1 / 0.212 = 4.72$$

Final answer: $K_c(\text{reverse}) = 4.72$. Reported to 3 significant figures

Problem 32 Solution

Given: Initially $[\text{PCl}_5] = 0.500 \text{ M}$. At equilibrium, $[\text{Cl}_2] = 0.200 \text{ M}$



Find: K_c

Because PCl_3 and Cl_2 form in a 1:1 ratio, $[\text{PCl}_3]$ also equals 0.200 M

$$K_c = [\text{PCl}_3][\text{Cl}_2] / [\text{PCl}_5]$$

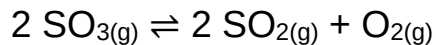
$$[\text{PCl}_5]_{\text{eq}} = 0.500 - 0.200 = 0.300 \text{ M}. \quad K_c = (0.200)(0.200) / 0.300 = 0.133$$

Final answer: $K_c = 0.133$. Reported to 3 significant figures

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Problem 45 Solution

Given: $K_c = 3.20 \times 10^{-2}$ for the first reaction



Find: K_c for the target reaction



The target is the reverse of the original reaction divided by 2, so take the reciprocal and then the square root

$$K_c(\text{target}) = \sqrt{(1 / K_c(\text{original}))}$$

$$K_c(\text{target}) = \sqrt{(1 / (3.20 \times 10^{-2}))} = \sqrt{(31.25)} = 5.59$$

Final answer: $K_c(\text{target}) = 5.59$. Reported to 3 significant figures

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Section 4. Answer Key

Problem	Answer
8	$K_c = 6.00$
16	$K_c(\text{reverse}) = 4.72$
32	$K_c = 0.133$
45	$K_c(\text{target}) = 5.59$

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