Northern Tutoring™

FREE SAMPLE

more worksheets with solutions

CHEMISTRY WORKSHEET

ENTHALPY

Course: SCH4U Grade 12 Chemistry

DOWNLOAD FULL WORKSHEET (PDF)

50 Practice Problems with Answers and Detailed Solutions

Full version of this worksheet contains 4 selected representative problems on:

✓Standard enthalpy of formation, ✓Calculating ΔH°_{rxn} from ΔH°_f, ✓Hess's Law scaling and reversing reactions, ✓ Calculating ΔH°_{rxn} from bond energies, ✓ Phase changes, combustion and decomposition enthalpy, ✓Limiting reagent enthalpy 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

Section 1 - Essential Information – included in full version

Section 2 - Practice Problems

Part A - Fundamental Problems (Problems 1-15)

Problem 8

Calculate $\Delta H°_{rxn}$ for $CO_{(g)} + 1/2O_{2(g)} \rightarrow CO_{2(g)}$ using $\Delta H°_f[CO_{2(g)}] = -393.5$ kJ/mol and $\Delta H°_f[CO_{(g)}] = -110.5$ kJ/mol

Part B - Intermediate Problems (Problems 16-30)

Problem 16

Calculate $\Delta H°_{rxn}$ for $CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(l)}$. Use $\Delta H°_f$ values: $CH_{4(g)}$ = -74.8 kJ/mol, $CO_{2(g)}$ = -393.5 kJ/mol, $H_2O_{(l)}$ = -285.8 kJ/mol

Part C - Advanced Problems (Problems 31-40)

Problem 32

The combustion of acetylene is $C_2H_{2(g)} + 5/2O_{2(g)} \rightarrow 2CO_{2(g)} + H_2O_{(l)}$,

$\Delta H°_{rxn} = -1299.6$ kJ.

Use $\Delta H°_f[CO_{2(g)}] = -393.5$ kJ/mol

and $\Delta H°_f[H_2O_{(l)}] = -285.8$ kJ/mol to calculate $\Delta H°_f[C_2H_{2(g)}]$

Part D - Challenge Problems (Problems 41-50)

Problem 45

For each proposed reaction, state whether it can be used directly as $\Delta H°_f$. If it cannot, explain the main reason:

A) $1/2N_{2(g)} + 3/2H_{2(g)} \rightarrow NH_{3(g)}$;

B) $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$;

C) $NH_4Cl_{(s)} \rightarrow NH_{3(g)} + HCl_{(g)}$;

D) $C_{(s,\ diamond)} + O_{2(g)} \rightarrow CO_{2(g)}$

Section 3 - Detailed Solutions

Each solution shows how to choose the method, how to handle signs, and how to connect the calculation to the balanced equation

Problem 8

Given: The products and reactants have tabulated formation enthalpies. Oxygen gas is an element in its standard state, so $\Delta H^\circ_f[O_{2(g)}] = 0$ kJ/mol

Find: Find ΔH°_{rxn} for the oxidation of carbon monoxide

Method: Use products minus reactants. The coefficient of $O_{2(g)}$ does not add heat because its formation enthalpy is zero

Formula: $\Delta H^\circ_{rxn} = \Sigma n \cdot \Delta H^\circ_f(\text{products}) - \Sigma n \cdot \Delta H^\circ_f(\text{reactants})$

Calculations: $\Delta H^\circ_{rxn} = [-393.5] - [-110.5 + 1/2(0)] = -283.0$ kJ

Final answer: $\Delta H^\circ_{rxn} = -283.0$ kJ

The result is reported to one decimal place because the tabulated values are given to one decimal place

DOWNLOAD FULL WORKSHEET (PDF)

Problem 16

Given: The reaction has one mole of methane, one mole of carbon dioxide, and two moles of liquid water. Oxygen gas has $\Delta H°_f$ = 0 kJ/mol because it is an element in its standard state

Find: Find $\Delta H°_{rxn}$ for methane combustion as written

Method: Use products minus reactants, multiplying every $\Delta H°_f$ value by its balanced coefficient. This method works because enthalpy is a state function

Formula: $\Delta H°_{rxn} = \Sigma n \cdot \Delta H°_f(\text{products}) - \Sigma n \cdot \Delta H°_f(\text{reactants})$

Calculations: $\Delta H°_{rxn} = [-393.5 + 2(-285.8)] - [-74.8 + 2(0)] = -965.1 + 74.8 = -890.3$ kJ

Final answer: $\Delta H°_{rxn} = -890.3$ kJ

The value is reported to one decimal place because the formation enthalpies are given to one decimal place

DOWNLOAD FULL WORKSHEET (PDF)

Problem 32

Given: The reaction enthalpy and product formation enthalpies are known. The unknown reactant formation enthalpy is $\Delta H°_f[C_2H_{2(g)}]$

Find: Find the standard enthalpy of formation of acetylene

Method: Set up products minus reactants and solve for the unknown. Oxygen gas is omitted from the numerical sum because its formation enthalpy is zero

Formula: $\Delta H°_{rxn} = [2\Delta H°_f(CO_2) + \Delta H°_f(H_2O)] - [\Delta H°_f(C_2H_2)]$

Calculations: $-1299.6 = [2(-393.5) + (-285.8)] - x$; $-1299.6 = -1072.8 - x$; $x = +226.8$ kJ/mol

Final answer: $\Delta H°_f[C_2H_{2(g)}] = +226.8$ kJ/mol

The answer is reported to one decimal place because all enthalpy values are given to one decimal place

DOWNLOAD FULL WORKSHEET (PDF)

Problem 45

Given: Four proposed reactions are given. A formation equation must form exactly 1 mol of compound from elements in their standard states

Find: Find which reactions qualify directly as standard enthalpy of formation reactions and why the others fail

Method: Check the product coefficient, reactant identities, and standard states. Diamond is not the standard state of carbon under standard conditions; graphite is

Formula: Valid ΔH°_f: standard-state elements → 1 mol of compound

Calculations: A is valid because it forms 1 mol $NH_{3(g)}$ from $N_{2(g)}$ and $H_{2(g)}$. B forms 2 mol, so it is twice a formation reaction. C starts from a compound and is a decomposition reaction. D forms 1 mol $CO_{2(g)}$, but carbon is diamond instead of graphite

Final answer: A yes; B no, forms 2 mol; C no, not from elements; D no, carbon is not in its standard state

No significant-figure rounding is needed because the answer is conceptual

DOWNLOAD FULL WORKSHEET (PDF)

Section 4 - Answer Key

Problem	Answer
8	$\Delta H^\circ_{rxn} = -283.0$ kJ
16	$\Delta H^\circ_{rxn} = -890.3$ kJ
32	$\Delta H^\circ_f[C_2H_{2(g)}] = +226.8$ kJ/mol
45	A yes; B no, forms 2 mol; C no, not from elements; D no, carbon is not in its standard state

DOWNLOAD FULL WORKSHEET (PDF)