Northern Tutoring™

FREE SAMPLE

more worksheets
with solutions

CHEMISTRY WORKSHEET

PHASE CHANGES

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:

✓Heating and cooling within one phase, ✓Melting and freezing, ✓Vaporization and condensation, ✓Multi-step heating and cooling curves, ✓Ice-water heat exchange, ✓Steam-water heat exchange, ✓Heater power and efficiency 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 Selected Problem 8	**PART B - INTERMEDIATE PROBLEMS** Selected Problem 16
PART C - ADVANCED PROBLEMS Selected Problem 32	**PART D - CHALLENGE PROBLEMS** Selected Problem 45

SUITABLE FOR:
quizzes, unit tests and final exam preparation

www.NorthernTutoring.ca/worksheets

Section 1 - Essential Information – included in full version

Section 2 - Practice Problems

Part A - Fundamental Problems (Problems 1-15)

Problem 8

How much heat is required to change 30.0 g of ice at -10.0 °C into liquid water at 25.0 °C? Use c_{ice} = 2.09 J/(g·°C), ΔHfus = 334 J/(g), and c_{water} = 4.184 J/(g·°C)

Part B - Intermediate Problems (Problems 16-30)

Problem 16

Calculate the heat needed to convert 80.0 g of ice at -20.0 °C into liquid water at 35.0 °C

Part C - Advanced Problems (Problems 31-40)

Problem 32

80.0 g of steam at 100.0 °C is bubbled into 500.0 g of water at 25.0 °C. Determine the final temperature and whether all the steam condenses

Part D - Challenge Problems (Problems 41-50)

Problem 45

A 30.0 g sample is heated with a 180 W heater. On its heating curve, the solid warms from -30.0 °C to 0.0 °C in 42.0 s, melts in 210 s, the liquid warms from 0.0 °C to 75.0 °C in 280 s, and boils in 960 s. Calculate c_{solid}, ΔHfus, c_{liquid}, and ΔHvap

[DOWNLOAD FULL WORKSHEET (PDF)]

Section 3 - Solutions

Problem 8 Solution

Given: The starting sample is 30.0 g of ice at -10.0 °C and the final sample is liquid water at 25.0 °C

Find: The total heat absorbed across the complete path from cold ice to warmer liquid water

Method: The path has three parts: warm ice to 0.0 °C, melt the ice, then warm the liquid water to 25.0 °C

Formula: $q_{total} = m \cdot c_{ice} \cdot \Delta T_{ice} + m \cdot \Delta Hfus + m \cdot c_{water} \cdot \Delta T_{water}$

q_{ice} = (30.0 g)(2.09 J/(g·°C))(10.0 °C) = 627 J

q_{melt} = (30.0 g)(334 J/(g)) = 10020 J

q_{water} = (30.0 g)(4.184 J/(g·°C))(25.0 °C) = 3138 J

q_{total} = 627 J + 10020 J + 3138 J = 13785 J = 13.785 kJ

Final answer: +13.8 kJ absorbed

The final answer is rounded to three significant figures because the measured values in the problem are mostly given to three significant figures

DOWNLOAD FULL WORKSHEET (PDF)

Problem 16 Solution

Given: The sample is 80.0 g of ice at -20.0 °C and the final state is liquid water at 35.0 °C

Find: The total heat absorbed from the initial solid state to the final liquid state

Method: The heating curve has three required sections: warming ice, melting ice, and warming liquid water

Formula: $q_{total} = m \cdot c_{ice} \cdot \Delta T_{ice} + m \cdot \Delta Hfus + m \cdot c_{water} \cdot \Delta T_{water}$

q_{ice} = (80.0 g)(2.09 J/(g·°C))(20.0 °C) = 3344 J

q_{melt} = (80.0 g)(334 J/(g)) = 26720 J

q_{water} = (80.0 g)(4.184 J/(g·°C))(35.0 °C) = 11715.2 J

q_{total} = 3344 J + 26720 J + 11715.2 J = 41779.2 J = 41.7792 kJ

Final answer: +41.8 kJ absorbed

The final answer is rounded to three significant figures because the measured values in the problem are mostly given to three significant figures

DOWNLOAD FULL WORKSHEET (PDF)

Problem 32 Solution

Given: There are 80.0 g of steam at 100.0 °C and 500.0 g of liquid water at 25.0 °C

Find: The final state of the system and the mass of steam that remains uncondensed

Method: First compare the heat needed to warm the water to 100.0 °C with the heat released if all the steam condensed

Formula: q_{water} to 100 = $m \cdot c_{water} \cdot \Delta T$ and mcondensed = q / ΔHvap

q_{water} to 100 = (500.0 g)(4.184 J/(g·°C))(75.0 °C) = 156900 J

If all 80.0 g of steam condensed, it would release (80.0 g)(2260 J/(g)) = 180800 J, which is more than needed to bring the water to 100.0 °C

The system reaches 100.0 °C before all steam condenses

mcondensed = 156900 J / 2260 J/(g) = 69.4248 g

m_{steam} remaining = 80.0 g - 69.4248 g = 10.5752 g

Final answer: T_f = 100.0 °C; 10.6 g of steam remains

The final answer is rounded to three significant figures because the measured values in the problem are mostly given to three significant figures

DOWNLOAD FULL WORKSHEET (PDF)

Problem 45 Solution

Given: The sample mass is 30.0 g and the heater power is 180 W. The heating curve gives times for solid warming, melting, liquid warming, and boiling

Find: The specific heat capacities and latent heats represented by the curve

Method: For each curve section, q = P·t. Sloped sections use q = m·c·ΔT, while plateaus use q = m·L

Formula: c = (P·t)/(m·ΔT) and L = (P·t)/m

c_{solid} = (180 J/s)(42.0 s) / [(30.0 g)(30.0 °C)] = 8.40 J/(g·°C)

ΔHfus = (180 J/s)(210 s) / 30.0 g = 1260 J/(g)

c_{liquid} = (180 J/s)(280 s) / [(30.0 g)(75.0 °C)] = 22.4 J/(g·°C)

ΔHvap = (180 J/s)(960 s) / 30.0 g = 5760 J/(g)

Final answer: c_{solid} = 8.40 J/(g·°C); ΔHfus = 1.26×10^3 J/(g); c_{liquid} = 22.4 J/(g·°C); ΔHvap = 5.76×10^3 J/(g)

The final answer is rounded to three significant figures because the measured values in the problem are mostly given to three significant figures

[DOWNLOAD FULL WORKSHEET (PDF)]

Section 4 - Answer Key

Problem	Answer
8	+13.8 kJ absorbed
16	+41.8 kJ absorbed
32	T_f = 100.0 °C; 10.6 g of steam remains
45	c_{solid} = 8.40 J/(g·°C); ΔHfus = 1.26 × 10^3 J/(g); c_{liquid} = 22.4 J/(g·°C); ΔHvap = 5.76 × 10^3 J/(g)

DOWNLOAD FULL WORKSHEET (PDF)