SI Chemistry - Full Discipline Demo

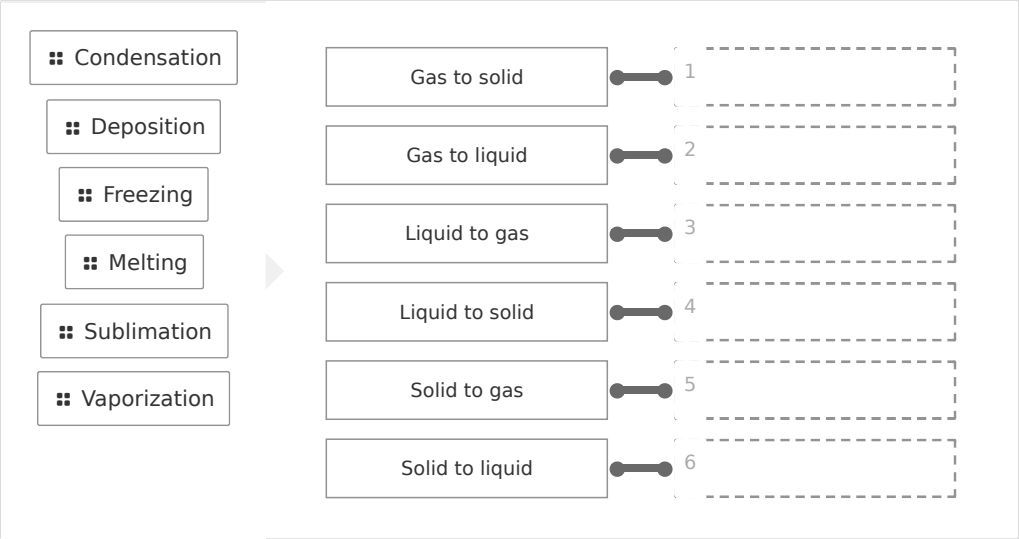
Digital States of Matter - Beyond Labz

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI Chemistry - Full Discipline Demo
Course	SI Chemistry - Full Discipline Demo
Instructor	Sales SI Demo

Test Your Knowledge

Match the terms to the transitions.

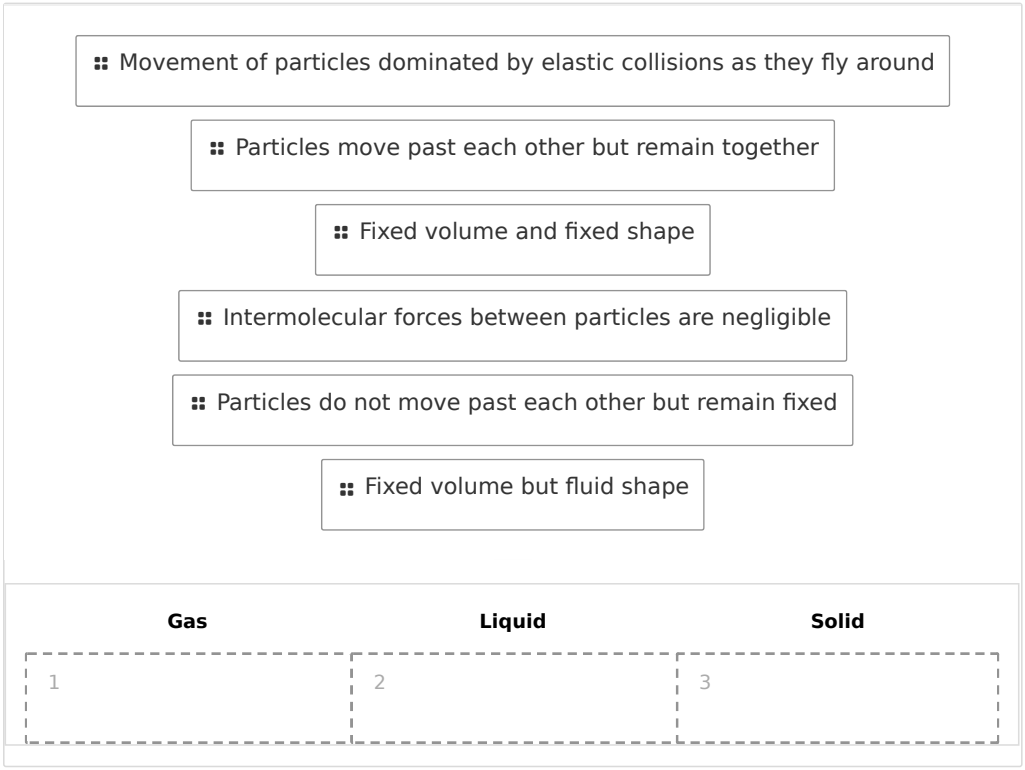


Correct answers:

1 Deposition 2 Condensation 3 Vaporization 4 Freezing

5 Sublimation 6 Melting

Classify each statement as describing a gas, liquid, or solid phase.



Correct answers:

1 Movement of particles dominated by elastic collisions as they fly around

Intermolecular forces between particles are negligible

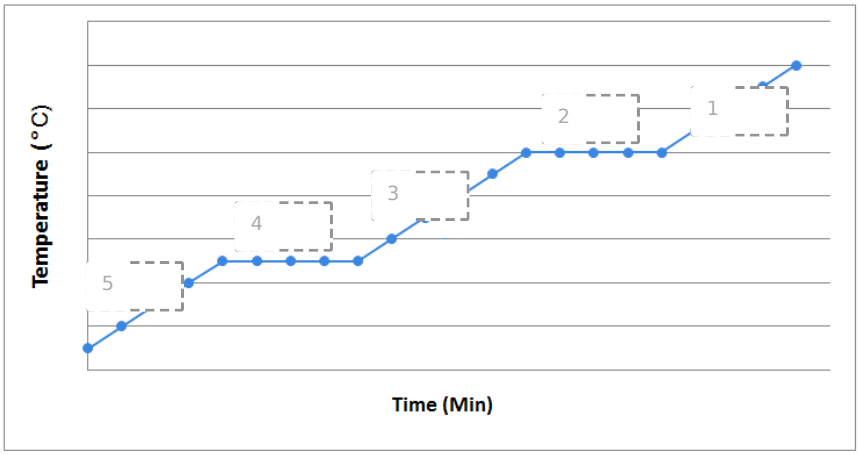
2 Particles move past each other but remain together

Fixed volume but fluid shape

3 Fixed volume and fixed shape

Particles do not move past each other but remain fixed

Label the heating curve with the appropriate state(s) of matter.



Liquid | Gas | Solid | Solid + Liquid | Liquid + Gas

Correct answers:

1 Gas 2 Liquid + Gas 3 Liquid 4 Solid + Liquid 5 Solid

Exploration

The liquid phase of matter has a ____ volume and a _____ shape.

- fixed; fixed
- fixed; fluid ✔
- fluid; fixed
- fluid; fluid

The extent to which _____ are overcome by the movement of particles is what determines if a substance is in solid, liquid, or gas form.

- condensations
- states of matter
- intermolecular forces ✔
- sublimations

The sublimation phase change involves a substance going from higher to lower internal energy.

- True
- False ✔

The change of state where a substance goes from a gas to a liquid is called _____.

- melting
- vaporization
- freezing
- condensation ✔

A heating curve is a flat line during _____.

- all heating processes
- phase changes ✔
- the liquid phase
- the heating of the solid

Exercise 1

What phase change is being investigated in this exercise? Reference the definition and properties of the two phases in your answer.

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Intermolecular forces are being overcome in the transition from solid to liquid. Describe the motion of particles before and after they undergo a melting process.

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The heat of fusion of water can tell us how much heat it would take to melt a certain amount of ice. If this experiment had been run with a large enough amount of ice that the water/ice solution reached the freezing temperature (0°C), would the heat of fusion be able to be calculated? Why or why not?

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Data Table 1: Calorimeter Experiment Values
(SAMPLE ANSWER BELOW)

Trial	**1**	**2**	**3**
Mass of water (g)	99.3924	99.4735	99.1219
Mass of ice (g)	25.9977	24.0654	25.0129
Starting temperature (°C)	25.00	25.00	25.00
Lowest temperature (°C)	4.36	5.69	4.54
ΔT (°C)	20.64	19.31	20.46
q (kJ)	8.575	8.029	8.477
Moles of ice (mol)	1.443	1.335	1.388
ΔH (kJ/mol)	5.942	6.014	6.107
Average ΔH (kJ/mol)	6.021		
Percent error	0.18%		

Image 1: Cooling Curve of Trial 1
(SAMPLE ANSWER BELOW)

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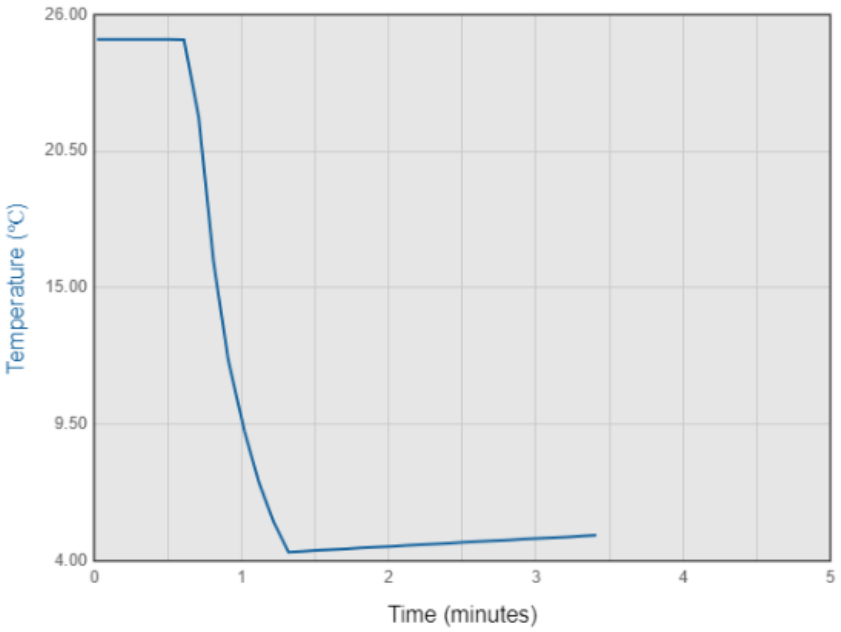

Image 2: Cooling Curve of Trial 2
(SAMPLE ANSWER BELOW)

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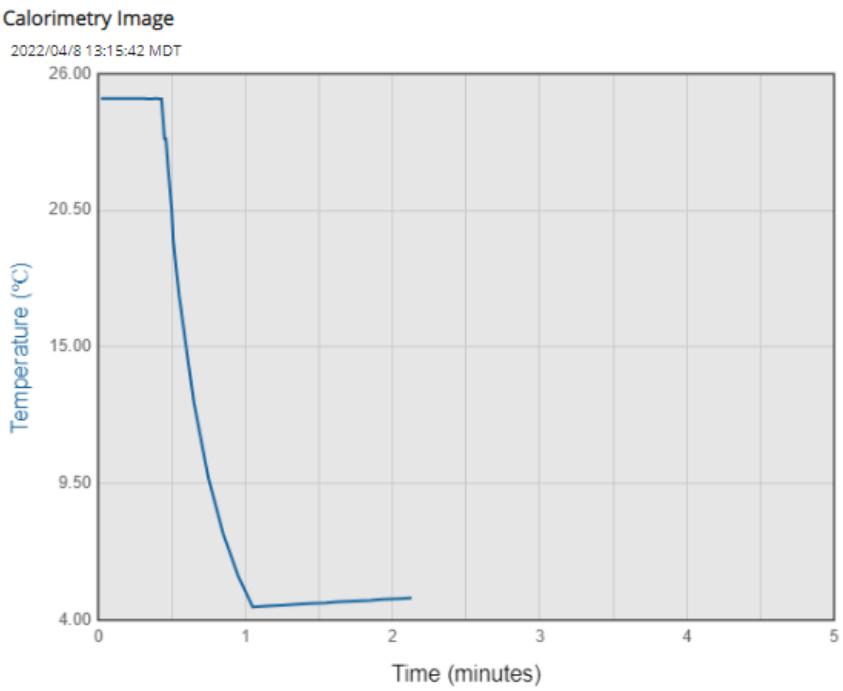

Image 3: Cooling Curve Trial 3

(SAMPLE ANSWER BELOW)

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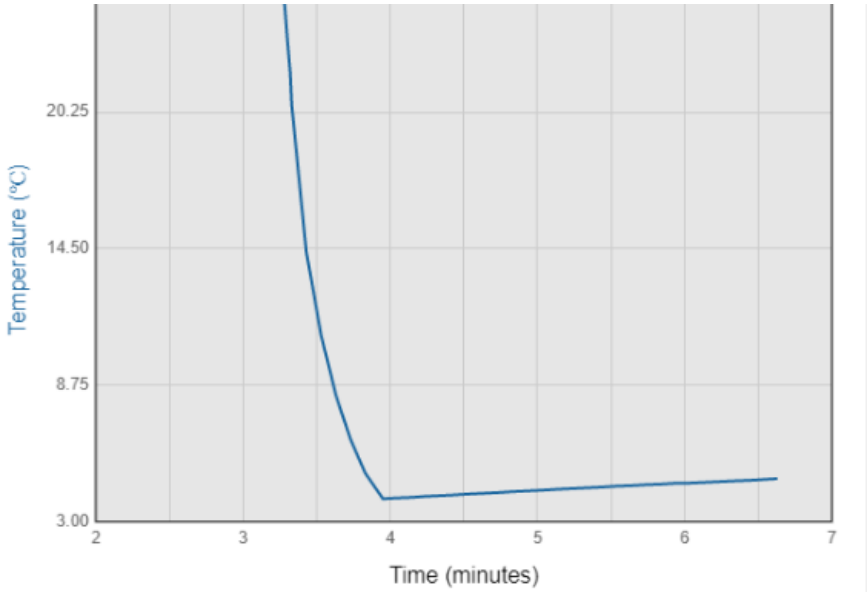

Exercise 2

What phase change is being investigated with the ΔH_{vap} in this exercise? Reference the definition and properties of the two phases in your answer.

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The magnitude of a ΔH value depends on the amount and strength of intermolecular forces being overcome in a phase change. Explain why the ΔH of vaporization is generally larger than the ΔH of fusion.

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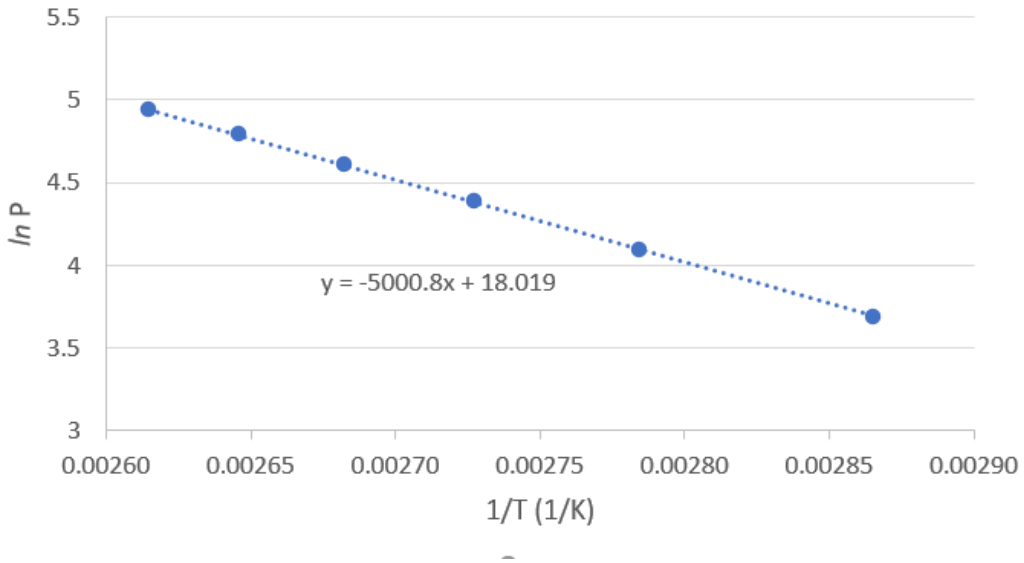
Data Table 2: Vapor Pressure of Water at Various Temperatures
(SAMPLE ANSWER BELOW)

Temperature (K)	**Pressure (kPa)**
382.47	140
377.97	120
372.79	100
366.67	80
359.11	60
349.03	40

Data Table 3: Modified Temperature and Pressure Values
(SAMPLE ANSWER BELOW)

1/Temperature (1/K)	***ln*(Pressure)**
0.002615	4.94
0.002646	4.79
0.002682	4.61
0.002727	4.38
0.002785	4.09
0.002865	3.69

Graph 1: Clausius-Clapeyron Graph
(SAMPLE ANSWER BELOW)



Data Table 4: Calculations

(SAMPLE ANSWER BELOW)

Slope *m* (K)	-5000.8 or -5000.0
ΔH_{vap} (kJ/mol)	41.6
Percent error	2.2%

Competency Review

A substance in the _____ phase of matter has no fixed volume or shape.

- solid
- liquid
- gas ✔
- None of the above

A phase change from a gas to a solid is known as _____.

- deposition ✔
- condensation
- sublimation
- vaporization

There is _____ in the temperature of a substance at the melting and boiling points during the melting or boiling process.

- no change ✔
- an increase
- a decrease
- a reversal

On a heating curve, as temperature increases over time, water is in the _____ phase(s) at or near a temperature of 0°C.

- solid
- solid or liquid ✔
- liquid or gas
- liquid

In the solid state, particle movement can be described as _____.

- elastic collisions between flying particles
- moving around by sliding over each other
- vibrating in place ✔
- complete stillness

Intermolecular forces are essentially negligible in the _____ state.

- solid
- liquid
- gas ✔
- plasma

The ΔH_{vap} is associated with how much heat is required to convert a certain amount of ___ particles into ____ particles.

- liquid; solid
- gas; liquid ✔
- solid; liquid
- gas; solid

A substance is melted in a calorimeter where the heat capacity of the calorimeter is 4.18 $^{J}/_{°C \cdot g}$ for 55.0 g of water and the temperature changed by 12.4°C. A total of 0.152 moles of the substance were used in the experiment. The heat of fusion for the substance is _____.

$$q = m \cdot C \cdot \Delta T$$

$$\Delta H_{fus} = \frac{q}{\text{moles ice}}$$

- 5.33 x 10^{-2} kJ/mol
- 5.33 x 10^{-5} kJ/mol
- 18,800 kJ/mol
- 18.8 kJ/mol ✔

The slope of a graph charting $^{1}/_{\text{temperature}}$ versus *ln*(pressure) for a certain gas is –2052.3 K. The ΔH_{vap} for this gas using the gas constant value 8.314 $^{J}/_{mol \cdot K}$ is _____.

$$\Delta H_{vap} = -m \cdot R$$

- [x] 17.06 kJ/mol
- [ ] 126.8 kJ/mol
- [ ] 17,060 kJ/mol
- [ ] 4.051 kJ/mol

The ΔT for a reaction in a calorimeter that starts at 34.0°C and over the course of a reaction increases to 41.3°C is 11.3°C.

- [x] True
- [ ] False

Extension Questions

In Exercise 2, the lowest temperature at which water vapor remained in the gas phase was higher as the pressure became higher. Describe what will happen to the vaporization temperature (or boiling point) of water at high altitudes, where the atmospheric pressure is much lower. (SAMPLE ANSWER BELOW)

The vaporization temperature will be lower, as the atmospheric pressure is lower and therefore in line with the trend noted in Exercise 2.
