

Phase Change

Purpose:

To describe how a sample of water, starting as ice at -100°C , behaves at the particle and the macroscopic level as heat is added to it at a constant rate.

Directions:

Record the temperature every 10 seconds. Make observations of the degree of structure, the particle movement, and the intermolecular forces for the three phases of matter and for the two phase transitions. Use the data to answer the questions in the **Analysis** section.

Table 1: Comparing the Three Phases of Matter

	Degree of Structure (Circle)	Particle Movement (Circle)	Intermolecular Forces (Circle)	Temp. Δ (Record values)
Solid	High Medium None	Rapid random motion Jiggle about fixed pos'n Vibrate and move about	High Medium None	-100°C to ____ $^{\circ}\text{C}$
Liquid	High Medium None	Rapid random motion Jiggle about fixed pos'n Vibrate and move about	High Medium None	____ $^{\circ}\text{C}$ to ____ $^{\circ}\text{C}$
Gas	High Medium None	Rapid random motion Jiggle about fixed pos'n Vibrate and move about	High Medium None	____ $^{\circ}\text{C}$ to ____ $^{\circ}\text{C}$

Table 2: Comparing Melting and Boiling

	Movement	IM Forces	Temp. Changing?
Melting	_____ with time Circle: Increasing, Decreasing	_____ with time Circle: Increasing, Decreasing	Circle: Yes No
Boiling	_____ with time Circle: Increasing, Decreasing	_____ with time Circle: Increasing, Decreasing	Circle: Yes No

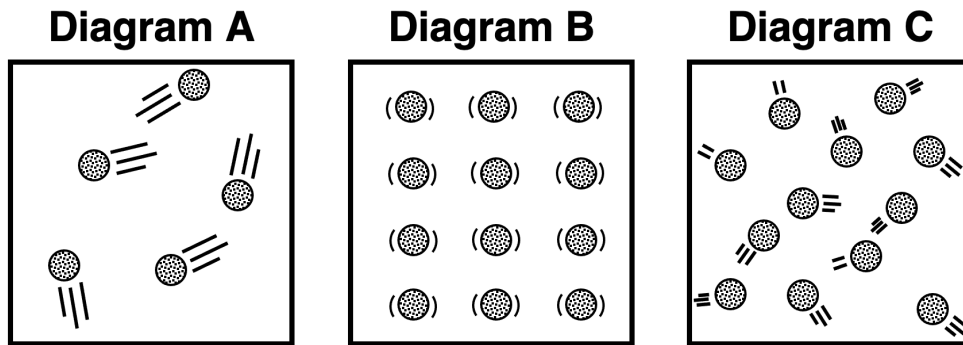
Table 3: Temperature-Time Data

Time (s)	Temp ($^{\circ}\text{C}$)	Time (s)	Temp ($^{\circ}\text{C}$)	Time (s)	Temp ($^{\circ}\text{C}$)	Time (s)	Temp ($^{\circ}\text{C}$)
0	-100	80		160		240	
10		90		170		250	
20		100		180		260	
30		110		190		270	
40		120		200		280	
50		130		210		290	
60		140		220		300	
70		150		230		310	

Analysis Questions:

1. Identify the phase of matter – solid, liquid, or gas – that ...
 - a. ... has the greatest amount of structure: _____
 - b. ... has the greatest amount of random motion of particles: _____
 - c. ... changes its temperature at the lowest rate: _____
 - d. ... has a shape that is independent of the container: _____
 - e. ... has no intermolecular forces: _____
 - f. ... has the strongest intermolecular forces: _____
 - g. ... has a shape and volume determined by the container: _____
 - h. ... the particles occupy the entire volume of the container: _____
 - i. ... the particles are close together but without any organization: _____

2. Consider the Particle Diagrams A, B, and C. Match each to the phase of matter.



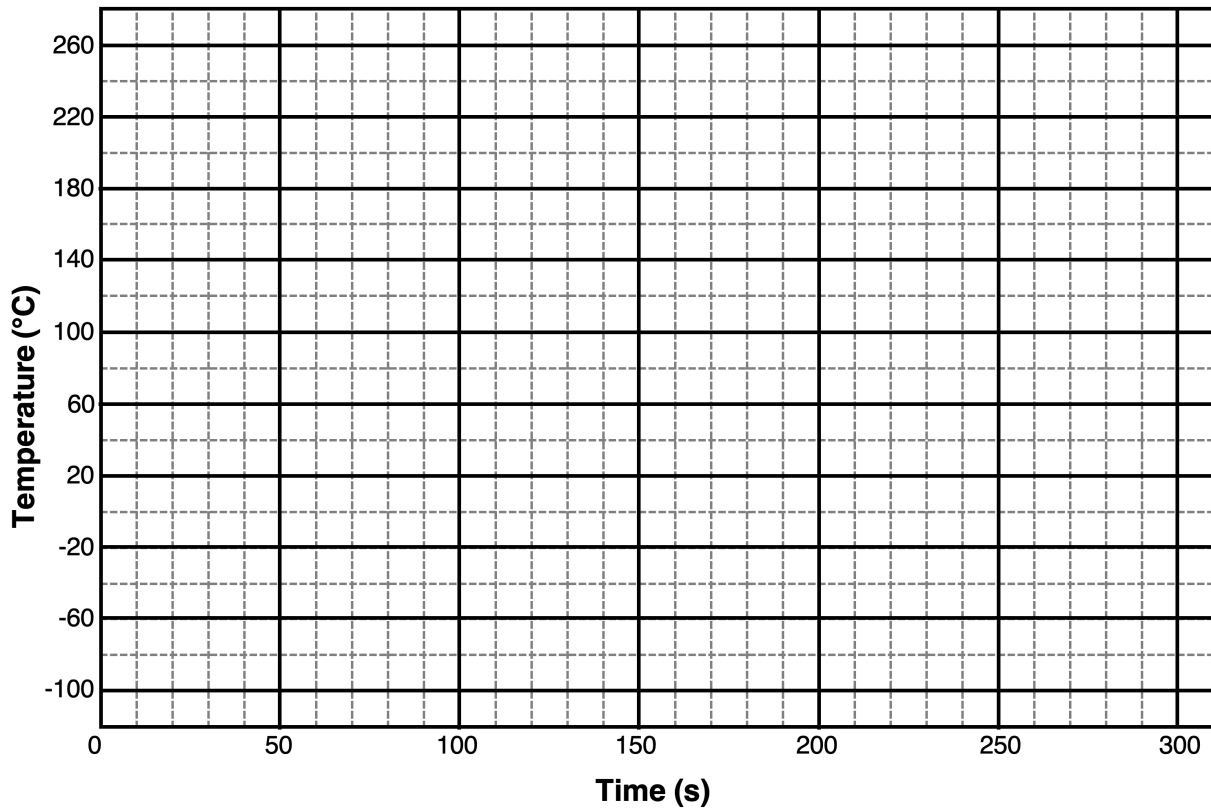
Phase → _____

3. **TRUE** or **FALSE**:

Adding heat to water always causes its temperature to increase.

If false, describe the evidence from the lab that refutes the statement.

4. Use data Table 3 to plot the temperature as a function of time. Draw five distinct, connecting lines on the graph with clear end points. We refer to this as a **heating curve**.



5. Place the following labels on the five distinct lines of the above graph to show the three phases and the two phase transitions: **solid liquid gas melting boiling**
6. Complete these two sentences:
 The phase changes are represented by _____ (horizontal, sloped) lines.
 The temperature changes are represented by _____ (horizontal, sloped) lines.
7. Circle the answers: What does the added heat do to water when the temperature is ...
- | | | | |
|------------|------------------------|------------------|---------------|
| a. - 30°C? | Change the temperature | Weaken IM Forces | Both of these |
| b. 0°C | Change the temperature | Weaken IM Forces | Both of these |
| c. 40°C | Change the temperature | Weaken IM Forces | Both of these |
| d. 100°C | Change the temperature | Weaken IM Forces | Both of these |
| e. 140°C | Change the temperature | Weaken IM Forces | Both of these |