AP CHEMISTRY • EXERCISE SHEET

6.5 Energy of Phase Changes

Name: _____ Class: _____ Date: _____ **Total: 9 marks**

KEY WORDS heat of fusion 熔化热 • phase change 相变 • heat of vaporization 汽化热 • heat 热量

Objective

Build the skills to answer exam questions on the **energy of phase changes**.

You must be able to:

- use the **heat of fusion** 熔化热 and **heat of vaporization** 汽化热
- explain the flat plateaus on a heating curve
- combine heating and phase-change steps

1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

■ Phase-change energy

Melting and boiling require energy to overcome intermolecular forces, at **constant temperature**:

$$q = n\,\Delta H_{\text{fus}} \quad \text{(melting)}, \qquad q = n\,\Delta H_{\text{vap}} \quad \text{(boiling)}.$$

■ Why the temperature is flat

During a phase change the added energy goes into **separating particles**, not raising their kinetic energy — so the temperature holds steady (the plateau on a heating curve).

■ Combining steps

To take ice below 0°C to steam, add up: warm ice ($mc\Delta T$) + melt ($n\Delta H_{\text{fus}}$) + warm water ($mc\Delta T$) + boil ($n\Delta H_{\text{vap}}$) + warm steam.

■ A worked plateau

Boiling always needs **more** energy than melting for the same substance ($\Delta H_{\text{vap}} > \Delta H_{\text{fus}}$), because boiling fully separates the particles.

2 Practice

Now apply the methods above.

2.1 During melting, what happens to the temperature? [1]

2.2 Write the equation for the heat to melt n moles of a solid. [1]

2.3 Which needs more energy per mole: melting or boiling (same substance)? [1]

3 Exam-style questions

3.1 During a phase change, added energy goes into [1]

- **A** raising the temperature
- **B** overcoming intermolecular forces
- **C** breaking covalent bonds
- **D** speeding up the particles

3.2 2.0 mol of ice melts. $\Delta H_{\text{fus}} = 6.0$ kJ/mol.

(a) Find the heat needed. [2]

(b) State what happens to the temperature during melting. [1]

3.3 Explain why the boiling plateau on a heating curve is longer than the melting plateau for the same substance and heating rate. [2]

Solutions

2.1 It stays constant.

2.2 $q = n\,\Delta H_{\text{fus}}$.

2.3 Boiling.

3.1 B — overcoming intermolecular forces.

3.2 (a) $q = (2.0)(6.0) = 12$ kJ. (b) The temperature stays constant (at the melting point).

3.3 Boiling requires more energy ($\Delta H_{\text{vap}} > \Delta H_{\text{fus}}$) because it fully separates the particles, so at the same heating rate it takes longer, giving a longer plateau.