4.1 Kinetic theory and latent heat

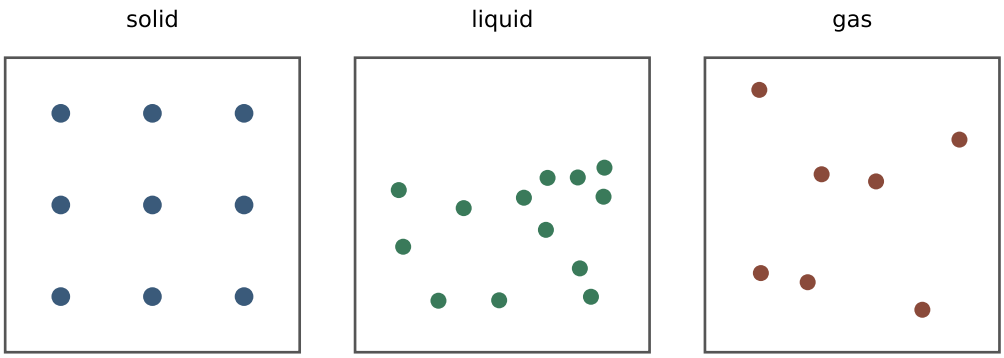
Name: _____ Class: _____ Date: _____ **Total: 17 marks**

Objective

Cover kinetic theory and changes of state (3.4.1): particle diagrams, E = mc$\Delta\theta$, (P) latent heats of vaporisation and fusion, impurities and the stearic-acid cooling-curve practical. Original OxfordAQA practice.

1 Key knowledge and worked examples

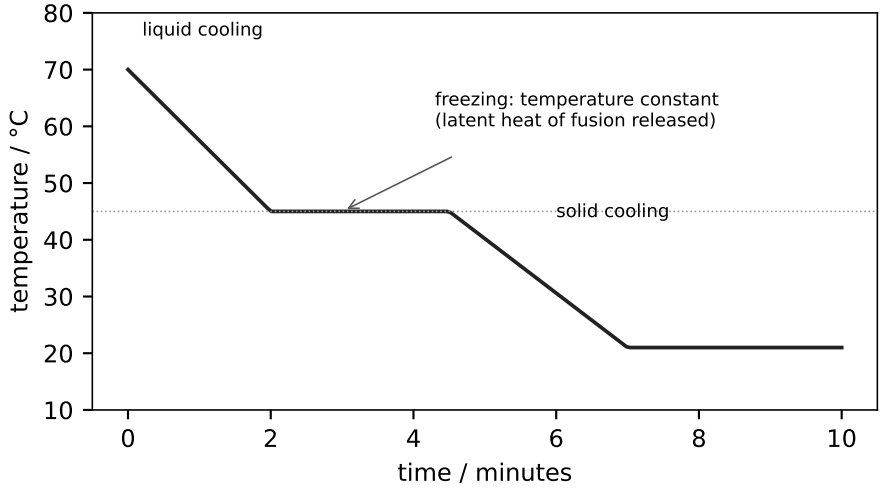
■ The model and its energies



$$E = mc\Delta\theta \quad (P)\ E = mL_V \quad (P)\ E = mL_F$$

Worked check. Boiling away 0.2 kg of water ($L_V = 2\,260\,000$ J/kg): $E = 0.2 \times 2.26 \times 10^6 = 452\,000$ J.

■ **(P) The cooling curve's flat shelf**



2 Practice

2.1 Describe the particle arrangement and motion in a gas. [2]

2.2 Define specific heat capacity. [1]

2.3 Calculate the energy to heat 0.8 kg of copper (c = 390) by 60 °C. [2]

2.4 (P) State what happens to temperature during boiling. [1]

2.5 (P) Calculate the energy to melt 1.2 kg of ice (L_F = 334 000 J/kg). [2]

3 Exam-style questions

3.1 A 2.5 kg block of a mystery material absorbs 45 000 J and warms by 20 °C. Calculate its specific heat capacity. [3]

3.2 (P) Sketch or describe the temperature–time graph for stearic acid cooling from 80 °C to room temperature, labelling the plateau. [3]

3.3 (P) Explain, in particle terms, why burns from steam at 100 °C are worse than burns from water at 100 °C. [3]

Solutions

2.1 Far apart (mostly empty space), moving fast in random straight-line paths between collisions.

2.2 The energy needed to change the temperature of 1 kg of a substance by 1 °C.

2.3 $E = 0.8 \times 390 \times 60 = 18\,720$ J.

2.4 (P) It stays constant.

2.5 (P) $E = 1.2 \times 334\,000 = 400\,800$ J.

3.1 $c = E/(m\Delta\theta) = 45\,000/(2.5 \times 20) = 900$ J/(kg °C).

3.2 (P) A falling line from 80 °C; a horizontal plateau at the freezing point while the liquid solidifies; then a falling line again down to room temperature.

3.3 (P) When steam condenses on skin it first releases its latent heat of vaporisation – a large extra energy transfer on top of the hot water's cooling – so more energy enters the skin for the same mass.