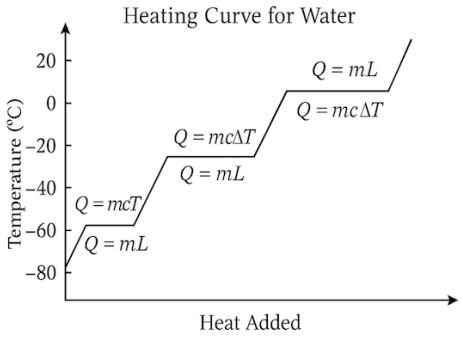
Year 11 Physics - Worksheet 2
Thermodynamics: Quantifying Heat Phase Change

Student Name: _____ ID: _____

Module 3

Part 1: Heating Curve Analysis (Knowledge Node N5 Analyse)

1. The graph below shows a typical heating curve for water, starting as ice below 0°C and ending as steam above 100°C. Energy is added at a constant rate.



(a) On the graph above, clearly **label** the 5 sections corresponding to: Heating Ice, Melting Ice, Heating Water, Boiling Water, Heating Steam.

(b) In which section(s) is the added energy increasing the *kinetic energy* of the particles the most? **Explain** your reasoning.

(c) In which section(s) is the added energy primarily increasing the *potential energy* (overcoming bonds) of the particles? **Explain** your reasoning. [Literacy N5]

(d) Indicate on the graph where the formula Q=mcT would be used to calculate energy added, and where Q=mL would be used.

[Numeracy Focus: Graph interpretation - N5]

2. **Define** the following terms:

- Specific Heat Capacity (c):

- Latent Heat of Fusion (Lf):

- Latent Heat of Vaporization (Lv):

[Literacy N3, N5]

Part 2: Calculations (Knowledge Nodes N3 Apply, N5 Apply)

(Use the provided data table for c and L values)

Worked Example 1 (Q=mcT): Calculate heat needed to warm 200g (0.2kg) water from 20°C to 50°C. ($c_{water} = 4186\,\text{J}\,\text{kg}^{-1}\,\text{K}^{-1}$) $Q = mc\Delta T = (0.2\,\text{kg})(4186\,\text{J}\,\text{kg}^{-1}\,\text{K}^{-1})(50 - 20\,\text{K}) = 25116\,\text{J}$

Worked Example 2 (Q=mL): Calculate heat needed to melt 50g (0.05kg) of ice at 0°C. ($L_{f,water} = 3.34 \times 10^5\,\text{J}\,\text{kg}^{-1}$) $Q = mL_f = (0.05\,\text{kg})(3.34 \times 10^5\,\text{J}\,\text{kg}^{-1}) = 16700\,\text{J}$

Practice Problems: Show your working clearly.

1. How much energy is released when 100g (0.1kg) of steam at 100°C condenses to water at 100°C? ($L_{v,water} = 2.26 \times 10^6\,\text{J}\,\text{kg}^{-1}$) [N5 Apply]

2. Calculate the total heat required to change 30g (0.03kg) of ice at -15°C to water at 40°C. ($c_{ice} = 2100\,\text{J}\,\text{kg}^{-1}\,\text{K}^{-1}$, $L_{f,water} = 3.34 \times 10^5\,\text{J}\,\text{kg}^{-1}$, $c_{water} = 4186\,\text{J}\,\text{kg}^{-1}\,\text{K}^{-1}$) [N3 Apply, N5 Apply] (Hint: This requires three steps: heating ice, melting ice, heating water). *[Numeracy Focus: Formula application, multi-step calculations - N3, N5]*

#MarkSense Quiz 2

Instructions: Choose the best answer for multiple choice questions. Show working for calculations.

Student Name: _____ **ID:** _____

1. During boiling, the energy added is primarily used to: [N5]

A. Increase particle kinetic energy

B. Increase Temperature

C. Break intermolecular bonds / Increase potential energy

D. Decrease volume

Answer: _____

2. Substance A has a specific heat capacity of 900 J/kg°C and substance B has c=450 J/kg°C. If 1kg of each substance absorbs 900J of heat, which statement is true? [N3]

A. Temp of A increases by 1°C, Temp of B increases by 2°C.

B. Temp of A increases by 2°C, Temp of B increases by 1°C.

C. Both increase temperature by 1°C.

D. Both increase temperature by 2°C.

Answer: _____

3. Calculate the heat energy needed to raise the temperature of 500g (0.5kg) of water from 20°C to 60°C. ($c_{water} = 4186\,\mathrm{J\,kg^{-1}\,K^{-1}}$). Show working. [N3 Apply] (2 marks)