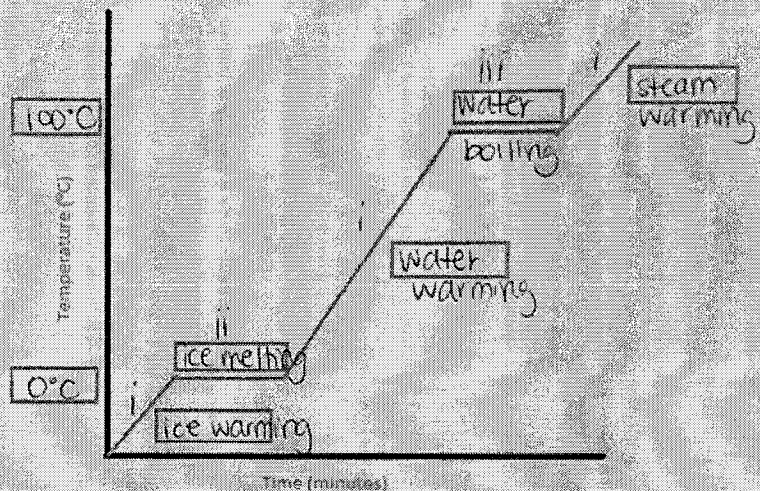


## Science 10 – Section D2.3 – Thermal energy transfer in the hydrosphere

1. Label the following heating curve of water. Include:

- The two temperatures on the vertical axis
- The event that is occurring at each point in the curve.
- At which point you would calculate  $Q$  using:

- $Q = mc\Delta t$
- $Q = \Delta H_{\text{fus}}n$
- $Q = \Delta H_{\text{vap}}n$



2. When reading a question, describe the key

piece of information that will indicate which of the two formulas to use ( $Q = mc\Delta t$  or  $Q = \Delta H n$ )

temp change or phase change.

3. Calculations – for each question, be sure to show your work including the formula used.

- Determine the quantity of thermal energy required to heat 100g of ice from  $-40^\circ\text{C}$  to  $0^\circ\text{C}$ .

$$Q = mc\Delta t$$

$$= (100\text{g})(2.00\text{ J/g}\cdot^\circ\text{C})(40^\circ\text{C})$$

$$= 8000\text{ J} = 8 \times 10^3\text{ J} \text{ or } 8\text{ kJ}$$

- Determine the quantity of thermal energy required to make that same 100 g of ice melt at  $0^\circ\text{C}$ . The theoretical heat of fusion of water is  $6.01\text{ kJ/mol}$  and the molar mass of water is  $18.02\text{ g/mol}$ .

$$Q = H_{\text{fus}} n$$

$$= (6.01\text{ kJ/mol})(5.55\text{ mol})$$

$$= 33.35\text{ kJ} = 33.4\text{ kJ}$$

$$n = \frac{m}{M} = \frac{100\text{ g}}{18.02\text{ g/mol}} = 5.55\text{ mol}$$

- Determine the quantity of thermal energy required to heat the 100g of water from  $0^\circ\text{C}$  to  $100^\circ\text{C}$ .

$$Q = mc\Delta t$$

$$= (100\text{g})(4.19\text{ J/g}\cdot^\circ\text{C})(100^\circ\text{C})$$

$$= 41900\text{ J} = 4.19 \times 10^4\text{ J} \text{ or } 41.9\text{ kJ}$$

- Determine the quantity of thermal energy required to make that same 100 g of water boil at  $100^\circ\text{C}$ . The theoretical heat of vaporization of water is  $40.66\text{ kJ/mol}$  and the molar mass of water is  $18.02\text{ g/mol}$ .

$$Q = H_{\text{vap}} n$$

$$= (40.66\text{ kJ/mol})(5.55\text{ mol}) = 225.66\text{ kJ} = 226\text{ kJ}$$

- Which stage required the most energy? Suggest an explanation.

- stage d  $\rightarrow$  boiling the water  
 - it takes a lot of energy to separate the particles of liquid water into gas