Chemistry 12 Date:________

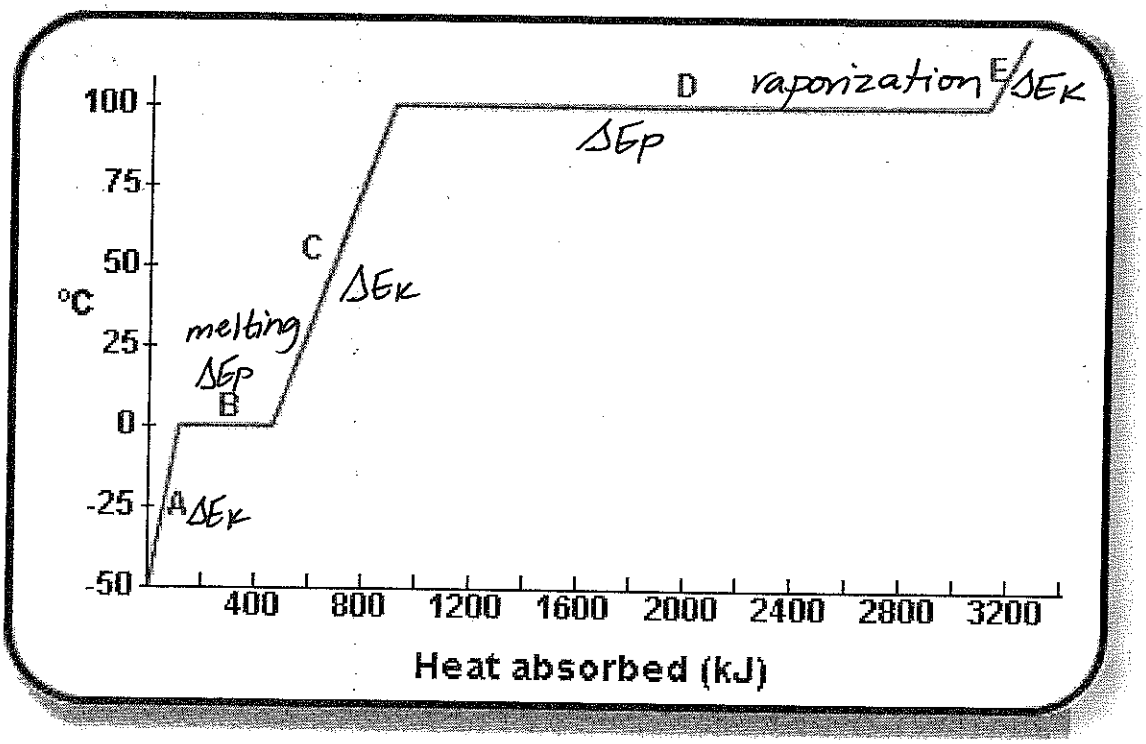
OBJECTIVE: *Students will construct heating and cooling curves. Calculate the amount of energy absorbed or released. Explain the regions of the graph in terms of state, kinetic and potential energy changes .*

HEATING AND COOLING CURVES

Warming or cooling involves a change in temp and the specific heat capacity. The heat flow is calculated using mcΔt, When a substance is warming, the energy absorbed by the system is used to move the particles faster. This is a change in Kinetic energy.

A phase change involves ~~a change in pot energy~~ no change in temp. and the energy added (heating) or removed (cooling) only changes the pot. energy. The potential energy is calculated using either
$\Delta H_{fus} = nH_{fus}$ or $\Delta H_{vap} = nH_{vap}$

Heating curve for water:

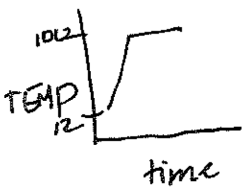


This diagram would be reversed for a cooling curve. This type of curve can be applied to any substance. The melting, boiling points, specific heat capacity and molar enthalpies would vary for each substance.

Region of the Curve	Process occurring	State(s)	Energy Change E_k or E_p	Formula used to calculate the energy change (q or ΔH)
A	heating	s	E_k	$mc\Delta t$
B	melting	s → l	E_p	$\Delta H_{fus} = nH_{fus}$
C	heating	l	E_k	$mc\Delta t$
D	vaporization	l → g	E_p	$\Delta H_{vap} = nH_{vap}$
E	heating	g	E_k	$mc\Delta t$

Problems:

a) **How much heat is required to completely change 2.5 g of water at 12°C to steam at 100. °C?**



① $mc\Delta t = 2.5g \cdot 4.19 J/g\cdot°C \cdot 88°C = 921.8J$

$\rightarrow 0.9218 kJ$

② $\Delta H_{fus} = nH_{fus}$

$n = \frac{m}{M} = \frac{2.5g}{18.02g/mol} = 0.139 mol$

$\Delta H_{fus} = 0.139 mol \cdot 6.03 kJ/mol$

$= 5.66 kJ$

$E_{total} = 0.9218 kJ + 5.66 kJ = 6.6 kJ$

b) **Find the heat released when 36.0 g of steam at 100.0 °C is condensed to water and cooled to 25.0 °C.**

c) **Calculate the total energy for 1000. g of molten iron at 1700.°C that changes to solid iron at 80. °C. The specific heat capacity of molten iron is 0.82 J/g•°C and that of solid iron is 0.52 J/g•°C. The molar enthalpy for iron is 15 kJ/mol at 1535°C (melting-freezing point).**