Heating and Cooling Curves

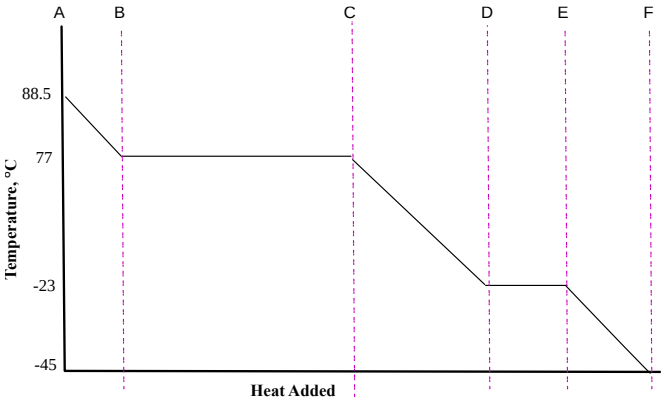
1. Calculate the total amount of energy, ΔH, required to cool a 34.5 g sample of CCl_4 from 88.5 °C to -45.0 °C. Use the information below to draw a labeled cooling curve.

c_s = 0.287 $\frac{J}{g \cdot °C}$ **Melting point = -23°C**

c_l = 0.866 $\frac{J}{g \cdot °C}$ **Boiling point = 77°C**

c_g = 0.577 $\frac{J}{g \cdot °C}$ **ΔH_{fus} = 2.5 kJ/mol**

ΔH_{vap} = 32.5 kJ/mol



ΔT_{AB}= 77°C – 88.5°C
ΔT_{CD} = -23°C – 77°C
ΔT_{EF} = -45.0°C –(-23°C)

Mm $CCl_4 = \frac{35.5\ g}{153.82\ g/mol} = 0.231\ mol\ CCl_4$

q_{AB} = 34.5 g x 0.577 $\frac{J}{g \cdot °C}$ x (-11.5°C) = -228.9 J = -0.2289 kJ

q_{BC} = -32.5 kJ/mol x 0.231 mol = -7.5 kJ

q_{CD} = 34.5 g x 0.866 $\frac{J}{g \cdot °C}$ x (-100 °C) = -2987.7 J = -2.9877 kJ

q_{DE} = -2.5 kJ/mol x 0.231 mol = -0.5775 kJ

q_{EF} = 34.5 g x 0.287 $\frac{J}{g \cdot °C}$ x -22 oC = -217.8 J = -0.2178 kJ

ΔH = -0.2289 kJ + -7.5 kJ + -2.9877 kJ + -0.5775 kJ + -0.2178 kJ = **-11.5 kJ**

The negative sign indicates the release of heat during the cooling.