Answer on Question #84726 – Chemistry – Other

Task:

Calculate the heat flow when 15.6 g solid benzene at 0.0°C is converted to liquid benzene at 5.5°C.

Solution:

Benzene freezes at 5.5°C = 278.65 K (melting point of benzene).

Heat capacity for solid benzene = 118.4 J/mol*K.

Enthalpy change of fusion for benzene = 9.9 kJ/mol.

Molar mass of benzene = 78.11 g/mol.

Convert these values from J/mol*K to J/K:

Heat capacity for solid benzene = C(C_6H_6, solid) = (118.4 J mol^{-1} K^{-1}) / (78.11 g mol^{-1}) = 1.516 J/K = 1.516 J/°C;

Heat capacity for solid benzene = 1.516 J/°C.

Enthalpy change of fusion for benzene = $\Delta_{fus}H°$ = (9900 J mol^{-1}) / (78.11 g mol^{-1}) = 126.744 J/g;

Enthalpy change of fusion for benzene = 126.744 J/g.

Solid benzene will release some of its internal energy to the surroundings when it heats and then melted.

1) heating the solid benzene from 0°C to 5.5°C;
2) melting the benzene.

1) **Heating solid benzene:**

$$\Delta Q = Cm\Delta T$$

$$\Delta Q_1 = Cm\Delta T = (1.516\,\text{J/g·°C})*(15.6\text{g})*(5.5°\text{C} - 0°\text{C}) = 130.073\,\text{J}$$

$$\Delta Q_1 = 130.073\,\text{J}$$

2) **Melting the solid benzene:**

$$\Delta Q = m * \Delta_{fus} H^o$$

$$\Delta Q_2 = m * \Delta_{fus} H^o = (15.6\text{g}) * (126.744\,\text{J/g}) = 1977.206\,\text{J}$$

$$\Delta Q_2 = 1977.206\,\text{J}$$

Finally, the total energy released is:

$$\Delta Q = \Delta Q_1 + \Delta Q_2 = 130.073\,\text{J} + 1977.206\,\text{J} = 2107.279\,\text{J}$$

$$\Delta Q = 2107.279\,\text{J} \approx 2.1\,\text{kJ}$$

Answer: Heat flow = 2.1 kJ.