Answer on Question #63208, Chemistry / General Chemistry

Chapter 11

Liquid butane (C4H10) and liquid propane (C3H8) are often stored in cylinders, to be used as fuels. The normal boiling point of butane is −0.5 °C and its ΔHvap is 23.1 kJ/mol. The corresponding values for propane are −42.1 °C and 15.4 kJ/mol, respectively.

1) How much energy is required to vaporize 135 g of butane at its boiling point? The heat of vaporization for butane is 23.1 kJ/mol.

2) What volume will 135 g of butane occupy at 745 torr and 35 ∘C?

Solution:

1) Molar mass (C_4H_{10}) = 58,12 g/mol

135 g / 58.12 g mol^{-1} = 2.3 mol

E = 2.3 mol x 23.1 kJ/mol = 53.7 kJ

2) We can solve this question by using the combined gas law equation:

[(P1)(V1)] / (T1) = [(P2)(V2)] / (T2)

We know that at STP, 1 mole of butane will occupy 22.4 Liters of volume.

1 mol C_4H_{10} = 58.124 g

1 mol C_4H_{10} = 22.4 L

[(135 C_4H_{10})/1][(1 mol C_4H_{10})/(58.12 g)][(22.4 L)/(1 mol C_4H_{10})] = 52 L C_4H_{10}

At STP conditions:

P_1 = 760 Torr

V_1 = 63.6 L

T_1 = 273 K

At given conditions:

P_2= 745 torr

V_2 = ?

T_2 = 35°C + 273 = 308 K

V_2 = [(P_1)(V_1)(T_2)] / [(T_1)(P_2)

V_2 = [(760. torr)(52 L)(308 K)] / [(273 K)(745 torr)

V_2 = 59.8 L

Answer: 1) 53.7 kJ and 2) 59.8 L