

Question #84763, Chemistry / General Chemistry

Question:

A 3.09 L flask is filled with propane gas (C₃H₈) at 1.00 atm and -16.4° C. What is the mass of the propane in the flask?

Solution:

The mass of the propane in the flask can be calculated from the Clapeyron-Mendeleev equation:

$$PV = \frac{m}{M}RT$$

where P – gas pressure, V – gas volume (in liters); T – gas temperature (in Kelvins); R – gas constant (0.0821 l×atm/mol×K), m – mass of gas, M - molar mass of gas in kg/mol.

The mass of propane can be calculated from the equation:

$$m = \frac{PVM}{RT}$$

$$T = (-16.4^{\circ} \text{C}) + 273.15 \text{ K} = 256.75 \text{ K}$$

$$M(\text{C}_3\text{H}_8) = (\text{Am}(\text{C}) \times 3) + (\text{Am}(\text{H}) \times 8) = 12 \times 3 + 1 \times 8 = 44 \text{ g/mol} = 4.4 \text{ kg/mol}$$

$$m = \frac{1.00 \text{ atm} \times 3.09 \text{ l} \times 4.4 \text{ kg/mol}}{0.0821 \frac{\text{latm}}{\text{molK}} \times 256.75 \text{ K}} = 0.645 \text{ kg}$$

Answer:

The mass of propane in flask is 0.645 kg or 645 g.