Answer on Question #71033 - Chemistry - General Chemistry

Question:

A sample contains both CO2 and Ne in unknown quantities. If the sample contains a combined total of 1.25 mol and has a total mass of 47.6 g , what are the percentages of CO2 and Ne in the sample by mass?

Solution:

To find a mass of each compound in the mixture the system of equations need to be solved:

$$\begin{cases} n(CO_2) + n(Ne) = 1.25 \; mol \\ m(CO_2) + m(Ne) = 47.6 \; g \end{cases}$$

We rewrite 1st equation as a ratio between the mass and molar mass of each compound and in 2nd derives the mass of carbon dioxide:

$$\begin{cases} n(CO_2) + n(Ne) = \dfrac{m(CO_2)}{M(CO_2)} + \dfrac{m(Ne)}{M(Ne)} = 1.25 \\ m(CO_2) = 47.6 - m(Ne) \end{cases}$$

Know we put 2nd equation into 1st and find the mass of Ne:

$$\frac{47.6 - m(Ne)}{M(CO_2)} + \frac{m(Ne)}{M(Ne)} = 1.25$$

$$\frac{M(Ne) \cdot (47.6 - m(Ne)) + \; M(CO_2) \cdot m(Ne)}{M(CO_2) \cdot M(Ne)} = 1.25$$

$$\frac{20 \cdot (47.6 - m(Ne)) + \; 44 \cdot m(Ne)}{44 \cdot 20} = 1.25$$

$$952 - 20 \cdot m(Ne) + 44 \cdot m(Ne) = 1100$$

$$m(Ne) = \frac{148}{24} = 6.2 g$$

When we put the mass of Ne to the 2nd equation we will find the mass of CO$_2$:

$$m(CO_2) = 47.6 - m(Ne) = 47.6 - 6.2 = 41.4 g$$

The percentages of each compound is the ratio of mass of each component to the mass of the mixture:

$$\% = \frac{m_{compound}}{m_{mixture}} \cdot 100\%$$

$$CO_2, \% = \frac{m_{CO_2}}{m_{mixture}} \cdot 100\% = \frac{41.4}{47.6} \cdot 100\% = 87\%$$

$$Ne, \% = \frac{m_{Ne}}{m_{mixture}} \cdot 100\% = \frac{6.2}{47.6} \cdot 100\% = 13\%$$

Answer: The percentages of compounds by mass are $CO_2, \% = 87\%; Ne, \% = 13\%$