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Chemistry Class 11 NCERT Solutions: Chapter 5 States of Matter Part 6

Q: 18. 2.9 g of a gas at 95 ° C occupied the same volume as 0.184 g of dihydrogen at 17 °C, at the same pressure. What is the molar mass of the gas?

Molar Mass of a Gas

- One of the methods chemists use to determine the molar mass of an unknown substance is to heat a weighed sample until it becomes a gas, measure the temperature, pressure, and volume, and use the ideal gas law to calculate the number of moles, then

$$\text{Molar Mass} = \frac{\text{mass in grams}}{\text{moles}}$$

Image Showing Molar Mass of a Gas.

Answer:

Volume (V) occupied by dihydrogen is given by,

$$\begin{aligned} V &= \frac{m}{M} \frac{RT}{p} \\ &= \frac{0.184}{2} \times \frac{R \times 290}{p} \end{aligned}$$

Let M be the molar of the unknown gas. Volume (V) occupied by the unknown gas can be calculated as: >

$$V = \frac{m}{M} \frac{RT}{p}$$

$$= \frac{2.9}{M} \times \frac{R \times 368}{p}$$

According to the question,

$$\begin{aligned} \frac{0.184}{2} \times \frac{R \times 290}{p} &= \frac{2.9}{M} \times \frac{R \times 368}{p} \\ \Rightarrow \frac{0.184 \times 290}{2} &= \frac{2.9 \times 368}{M} \\ \Rightarrow M &= \frac{2.9 \times 368 \times 2}{0.184 \times 290} \\ &= 40 \text{ g mol}^{-1} \end{aligned}$$

Hence, the molar mass of the gas is 40 g mol^{-1} .

Q: 19. A mixtures of dihydrogen and Dioxygen at one bar pressure contain 20% by weight of dihydrogen. Calculate the partial pressure of dihydrogen.

Answer:

Let the weight of dihydrogen be 20 g and the weight of Dioxygen be 80 g.

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Then, the number of moles of dihydrogen, $n_{H_2} = \frac{20}{2} = 10 \text{ moles}$ and the number of moles

Of Dioxygen, $n_{O_2} = \frac{80}{32} = 2.5 \text{ moles}$

Given,

Total pressure of the mixture, $p_{total} = 1 \text{ bar}$

Then, partial pressure of dihydrogen,

$$\begin{aligned} p_{H_2} &= \frac{n_{H_2}}{n_{H_2} + n_{O_2}} \times p_{total} \\ &= \frac{10}{10 + 2.5} \times 1 \\ &= 0.8 \text{ bar} \end{aligned}$$

Hence, the partial pressure of dihydrogen is **0.8 bar**.

Q: 20. What would be the SI unit for the quantity $\frac{pV^2T^2}{n}$?

Answer:

The SI unit for pressure, p is Nm^{-2} .

The SI unit for volume, V is m^3 .

The **SI unit for temperature, T is K .**

The SI unit for the number of moles n is mol.

$$pV^2T^2$$

Therefore, the SI unit for quantity $\frac{pV^2T^2}{n}$ is given by,

$$\begin{aligned} &= \frac{(\text{Nm}^{-2})(\text{m}^3)^2(\text{K})^2}{\text{mol}} \\ &= \text{Nm}^4\text{K}^2\text{mol}^{-1} \end{aligned}$$

Q: 21. In terms of Charles' law explain why -273°C is the lowest possible temperature.

Answer:

Charles' law states that constant pressure, the volume of a fixed mass of gas is directly proportional to its absolute temperature.