Chemistry Class 11 NCERT Solutions: Chapter 5 States of Matter Part 4

Q: 10. 34.05 mL of phosphorus vapour weighs 0.0625 g at 546 °C and 0.1 bar pressure. What is the molar mass of phosphorus?

Answer:

Given,

$$P = 0.1\ bar$$

$$V = 34.05\ mL = 34.05 \times 10^{-3}\ L = 34.05 \times 10^{-3}\ dm^3$$

$$R = 0.083\ bar\ dm^3 K^{-1}\ mol^{-1}$$

$$T = 546°C = (546 + 273)K = 819\ K$$

The number of moles (n) can be calculated using the ideal gas equation as:

$$pV = nRT$$

$$\Rightarrow n = \frac{pV}{RT}$$

$$= \frac{0.1 \times 34.05 \times 10^{-3}}{0.083 \times 819} = 5.01 \times 10^{-5}\ mol$$

Therefore, molar mass of phosphorus $= \frac{0.0625}{5.01 \times 10^{-5}} = 1247.5\ \text{g mol}^{-1}$

Hence, the molar mass of phosphorus is $1247.5\ \text{g mol}^{-1}$.

Q: 11. A student forgot to add the reaction mixture to the round bottomed flask at $27\ °C$ but instead he/she placed the flask on the flame. After a lapse of time, he realized his mistake, and using pyrometer, he found the temperature of the flask was 477 ° C. What fraction of air would have been expelled out?

Answer:

Let the volume of the round bottomed flask be V.

Then, the volume of air inside the flask at $27\ °C$ is V.

Now,

$$V_1 = V$$

$$T_1 = 27°C = 300K$$

$V_2 = ?$

$T_2 = 477\,°C = 750\,K$

According to Charles's law,

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\Rightarrow V_2 = \frac{V_1\,T_2}{T_1}$$

$$= \frac{750V}{300}$$

$$= 2.5\,V$$

Therefore, volume of air expelled out $= 2.5\,V - V = 1.5\,V$

Hence, fraction of air expelled out $= \frac{1.5V}{2.5V} = \frac{3}{5}$

Q: 12. Calculate the temperature of 4.0 mol of gas occupying $5\,dm^3$ at $3.32\,bar$. $\left(R = 0.083\,bar\,dm^3\,K^{-1}\,mol^{-1}\right)$.

Answer

Given,

$n = 4.0\,mol$

$V = 5\,dm^3$

$p = 3.32\,bar$

$R = 0.083\,bar\,dm^3\,K^{-1}\,mol^{-1}$

The temperature (T) can be calculated using the ideal gas equation as:

$$pV = nRT$$

$$\Rightarrow T = \frac{pV}{nR}$$

$$= \frac{3.32 \times 5}{4 \times 0.083}$$

$$= 50K$$

Hence, the required temperature is 50 K.

Q: 13. Calculate the total number of electrons present in $1.4\,g$ of dinitrogen gas.

Answer:

Molar mass of dinitrogen $(N_2) = 28g\ mol^{-1}$

$$\text{Thus, } 1.4 \text{ g of N \_ 2} = \frac{1.4}{28} = 0.05 \text{ mol}$$

$$= 0.05 \times 6.02 \times 10^{23} \textit{number of molecules}$$

$$= 3.01 \times 10^{23} \textit{ number of molecules}$$

Now, 1 molecule of N_2 contains 14 electrons.

Therefore, $3.01 \times\ 10^{23}$ molecules of N_2 contains =14× 3.01× 10^{23}

$= 4.214 \times 10^{23}$ electrons

Q: 14. How much time would it take to distribute one Avogadro number of wheat grains, if 10^{10} grains are distributed each second?

Answer:

Avogadro number= 6.02×10^{23}

Thus, time required

$$= \frac{6.02 \times 10^{23}}{10^{10}} \text{s} = 6.02 \times 10^{23} s$$

$$= \frac{6.02 \times 10^{23}}{60 \times 60 \times 24 \times 365} years$$

$$= 1.909 \times 10 \times 10^{6} years$$

Hence, the time taken would be $1.909 \times 10^{6} years$.