

## 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: >

$$\begin{aligned} V &= \frac{m}{M} \frac{RT}{p} \\ &= \frac{2.9}{M} \times \frac{R \times 368}{p} \end{aligned}$$

According to the question,

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

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

Q: 19. A mixture 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.

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  $0.8 \text{ bar}$ .

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

Answer:

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

The SI unit for volume,  $V$  is  $\text{m}^3$ .

The SI unit for temperature,  $T$  is  $\text{K}$ .

The SI unit for the number of moles  $n$  is  $\text{mol}$ .

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$$pV^2T^2$$

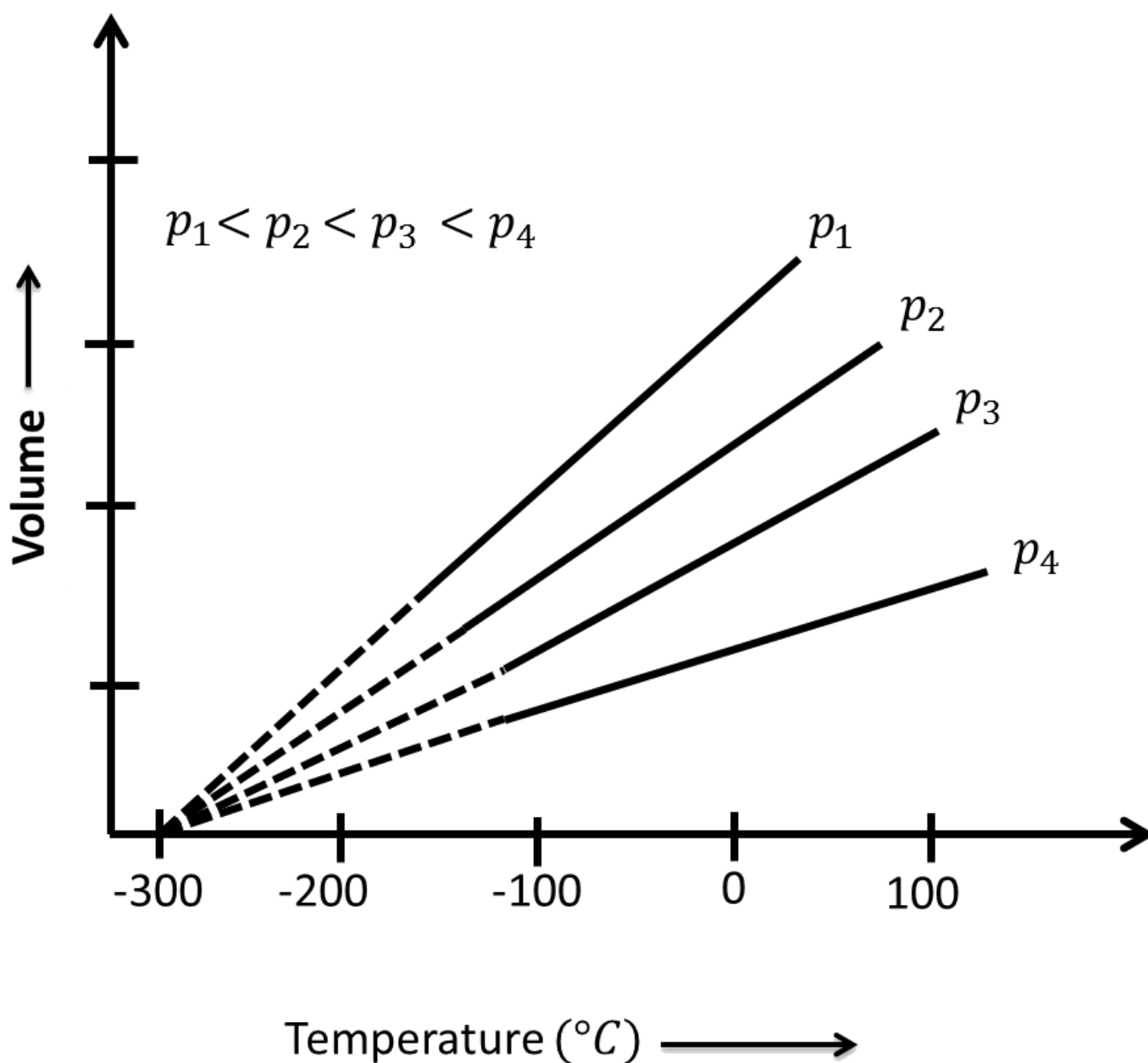
Therefore, the SI unit for quantity  $\frac{pV^2T^2}{n}$  is given by,

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

Q: 21. In terms of Charles' law explain why  $-273^\circ\text{C}$  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.



It was found that for all gases (at any given pressure), the plots of volume vs. temperature (in  $^\circ\text{C}$ ) is a straight line. If this line is extended to zero volume, then it intersects the temperature-

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axis at  $-273^{\circ}\text{C}$ . In other words, the volume of any gas at  $-273^{\circ}\text{C}$  is zero. This is because all gases get liquefied before reaching a temperature of  $-273^{\circ}\text{C}$ . Hence, it can be concluded that  $-273^{\circ}\text{C}$  is the lowest possible temperature.

Q: 22. Critical temperature for carbon dioxide and methane are  $31.1^{\circ}\text{C}$  and  $-81.9^{\circ}\text{C}$  respectively. Which of these has stronger intermolecular forces and why?

Answer:

Higher is the critical temperature of a gas, easier is its liquefaction. This means that the intermolecular forces of attraction between the molecules of a gas are directly proportional to its critical temperature; Hence, intermolecular forces of attraction are stronger in the case of  $\text{CO}_2$ .