CHEMISTRY CLASS XI
CHAPTER – 5 STATES OF MATTER

Q.1. Name two intermolecular forces that exist between HF molecules in liquid state.

Ans. HF are polar covalent molecules. In liquid state, there are dipole-dipole interactions and H-bonding.

Q.2. Explain why Boyle's law cannot be used to calculate the volume of a real gas when it is converted from its initial state by an adiabatic expansion.

Ans. During adiabatic expansion, temperature is lowered and therefore, Boyle's law cannot be applied.

Q.3. Boyle's law states that at constant temperature, if pressure is increased on a gas, volume decreases and vice-versa. But when we fill air in a balloon, volume as well as pressure increase. Why?

Ans. The law is applicable only for a definite mass of the gas. As we fill air into the balloon, we are introducing more and more air into the balloon.

Thus, we are increasing the mass of air inside. Hence, the law is not applicable.

Q.4. What would be the SI unit for the quantity Pv^2T^2/n ?

Ans. $\frac{pV^2T^2}{n} = \frac{(Nm^{-2})(m^3)(k)^2}{mol}$

$= Nm^4K^2\ mol^{-1}$

Q.5. What will be the molar volume of nitrogen and argon at 273.15 and 1 atm?

Ans. Every gas has 22.4L molar volume at 273.15 K and 1 atm pressure (STP).

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Q.6. Pressure exerted by saturated water vapour in called aqueous tension. What correction term will you apply to the total pressure to obtain pressure of dry gas?

Ans. $P_{dry\ gas} = P_{moist\ gas}$ (i.e., total pressure) – aqeous tension

Q.7. On the basis of intermolecular forces and thermal energy, explain why

(i) a solid has rigidity but liquids do not have rigidity?

(ii) gases have high compressibility but liquids and solids have poor compressibility?

Ans. (i) It is because in solids, the intermolecular forces are very strong and predominate over thermal energy but in liquid, these forces are no longer strong enough.

(ii) Because of very weak intermolecular forces and high thermal energy, molecules of gases are far apart. That is why gases are highly compressible.

Q.8. A balloon filled with an ideal gas is taken from the surface of the sea deep to a depth of 100 m. What will be its volume in terms of its original volume?

Ans. Pressure at the surface = 76 cm = 76 × 13.6 cm Hg

= 1033.4 cm of Hg = 10.3 m of Hg

∴ Pressure at 100 m depth = 100 + 10.3 m = 110.3 m

Applying p_1V_1, (At surface) = p_2V_2, (At 100 m depth)

$10.3 \times V = 110.3 \times V_2$

or $V_2 = 0.093\ V = 9.3\%$ of V

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Q.5. A human adult breathes in approximately 0.50 L of air at 1 atm with each breath. If an air tank holds 10 L of air at 200 atm, how many breaths the tank will supply?

Ans. $p_1V_1 = p_2V_2 \Longrightarrow 200 \times 10 = 1 \times V_2$

or $V_2 = 2000$ L

Therefore, number of breaths = $\frac{2000L}{0.5\ L}$

= 4000

Q.6. Calculate the temperature of 4.0 moles of a gas occupying 5 dm^3 at 3.32 bar.

(R = 0.083 bar dm^3 K^{-1} mol^{-1}).

Ans. Apply ideal gas equation, pV = nRT

$$T = \frac{pV}{Rn} = \frac{3.32bar \times 5dm^3}{0.083\ bar\ dm^2K^{-1}mol^{-1} \times 4\ mol}$$

T = 50 K

Q.7. 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?

Ans. $pV = nRT = \frac{mRT}{M}$

(m = mass of phosphorus (g) and M = molar mass of phosphorus)

$$M = \frac{mRT}{pV}$$

$$M = \frac{0.0625g \times 0.0821\ L\ atm\ K^{-1}mol^{-1} \times 819\ K}{0.1 \times 0.987\ atm \times 0.03405\ L}$$

M = 1250.4 g mol^{-1}

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Q.8. Calculate the volume occupied by 8.8 g of CO_2 at 31.1°C and 1 bar pressure. R = 0.083 bar L k^{-1} mol^{-1}.

Ans. $pV = nRT$ or pV = $\frac{m}{M}$ RT

Volume ooccupied by 8.8 g of CO_2,

$$V = \frac{mRT}{pM} = \frac{8.8g\ \times 0.083 barLK^{-1}mol^{-1} \times 304.1K}{1\ bar\ \times\ 44g\ \ mol^{-1}}$$

V = 5.048 L

Q.9. Value of universal gas constant (R) is same for all gases. What is its physical significance?

Ans. From the gas equation, pV = nRT, R = $\frac{pV}{nT}$. If p is measured in Pascal, V/n i.e., molar volume per mole in m^3 and T in kelvin, units of R are Pa $m^3 K^{-1}$ mol^{-1} or J $mol^{-1}K^{-1}$. As joule is the unit of work, R is the work done per mole per kelvin.

Q.10. A 2.0 L container at 25° C contain 1.25 moles of O_2 and 3.2 moles of C.

(i) What is the initial pressure in the flask?

(ii) If the carbon and oxygen react as completely as possible to form CO, what will be the final pressure in the container?

Ans. (i) The container contains 1.25 moles of O_2 and 3.2 moles of C. Since only oxygen is gaseous and carbon will not exert any pressure.

n = 1.25 mol, V = 2.0 L, T = 273 + 25 = 298 K

$$\therefore p = \frac{nRT}{V}$$

$$= \frac{(1.25\ mol) \times (0.0821\ L\ atm\ mol^{-1}k^{-1})(298\ K)}{(2.0\ L)}$$

= 15.3 atm

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(ii) The reaction is C + $\frac{1}{2}O_2 \longrightarrow$ CO

According to the equation, 1 mole of CO will be produced for every 1/2 mole of O_2 used.

$\frac{1}{2}$ mole of O_2 gives CO = 1 mole

1.25 mol of O_2 will give CO = 1 × 2 × 1.25

= 2.50 mol

∴ Final pressure

$$p = \frac{(2.50\ mol)\times(0.0821\ L\ atm\ K^{-1}mol^{-1})\times(298\ K)}{2.0\ L}$$

= 30.6 atm

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