PHYSICAL CHEMISTRY

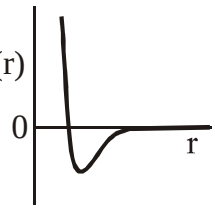
REAL GAS

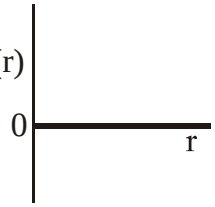
1. A gas has a compressibility factor of 0.5 and a molar volume of 0.4 $dm^3\ mol^{-1}$ at a temperature of 800 K and pressure **x** atm. If it shows ideal gas behaviour at the same temperature and pressure, the molar volume will be **y** $dm^3\ mol^{-1}$. The value of **x**/**y** is _____. **[JEE(Advanced) 2023]**

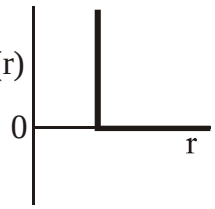
[Use: Gas constant, $R = 8 \times 10^{-2}$ L atm $K^{-1}\ mol^{-1}$]

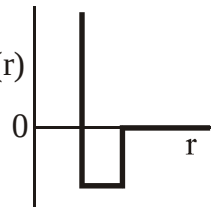
2. One mole of a monoatomic real gas satisfied the equation p(V– b) = RT where b is a constant. The relationship of interatomic potential V(r) and interatomic distance r for the gas is given by –

[JEE(Advanced) 2015]

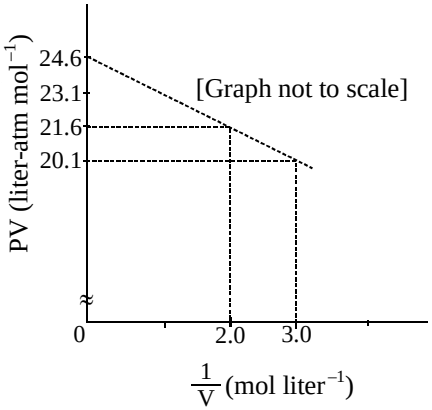
(A) 

(B) 

(C) 

(D) 

3. For one mole of a van der Waals gas when b = 0 and T=300K, the PV vs. 1/V plot is shown below. The value of the van der Waals constant a (atm. $liter^2\ mol^{-2}$) is **[IIT-JEE 2012]**



(A) 1.0 (B) 4.5 (C) 1.5 (D) 3.0

SOLUTIONS

1. Ans. (100)

Sol. For gas : Z = 0.5, V_m = 0.4 L/mol

T = 800 K, P = X atm.

$$\Rightarrow \quad Z = \frac{PV_m}{RT}$$

$$\Rightarrow \quad \frac{X(0.4)}{0.08\times 800} = 0.5$$

$$\Rightarrow \quad X = 80$$

For ideal gas, $PV_m = RT$

$$\Rightarrow \quad V_m = \frac{RT}{P} = \frac{0.08\times 800}{80} = 0.8 \text{ L mol}^{-1} = y$$

Then, $\frac{x}{y} = \frac{80}{0.8} = 100$

2. Ans. (C)

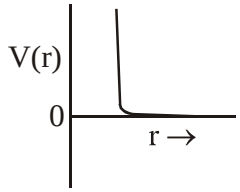
Sol. P (V- b) = RT

$\because a = 0$

Since only repulsive forces are present.

Repulsive forces contribute only at very close distance.

So potential energy increases abruptly.



3. Ans. (C)

Sol. $\left(P + \frac{a}{V^2}\right)(V - 0) = RT$ as (n = 1)

$$PV = RT - \frac{a}{V}$$

On comparing slope from graph

$$-a = \frac{20.1 - 21.6}{3 - 2}$$

$$-a = \frac{-1.5}{1} = a = 1.5$$