

PASSAGE

The ideal gas laws can be summed up as the ideal gas equation below :

$$PR = nRT$$

In many instances, the ideal gas equation can be used for actual gases provided certain conditions are met. However, under conditions of high pressure and/or relatively low temperature, gases behave differently than would be expected using the ideal gas equation. In these situations, the Van der Waals equation provides a better approximation :

$$\left(P + \frac{n^2a}{V^2} \right) (V - nb) = nRT$$

Where a and b are constants specific for each gas.

- Q.1** Two identical evacuated flasks of negligible weight are filled with different gases to the same pressure. One is filled with hydrogen and the other with propane. Compared with the first flask, the flask filled with propane weighs-
- (A) 11 times more (B) 22 times more (C) The same (D) 44 times more.
- Q.2** A soccer ball with initial pressure P and initial volume V is inflated with air until the pressure is 2P and the volume is 1.1V. Temperature is kept constant. The weight of air in the ball has increased by a factor of-
- (A) 2.2 (B) 1.1 (C) 1.0 (D) 2.0
- Q.3** Assume the composition by volume of air is N₂ 80% and O₂ 20%. Which of the following gases are denser than air assuming the same temperature and pressure ?
- CH₄, Cl₂, CO₂, NH₃, NO₂, O₂, SO₂
- (A) CH₄, CO₂, Cl₂, SO₂ (B) CO₂, Cl₂, SO₂, NH₃, O₃
 (C) Cl₂, CO₂, NH₃, NO₂, O₃, SO₂ (D) Cl₂, CO₂, NO₂, O₃, SO₂
- Q.4** Given that the critical temperature of oxygen is 154 K and its critical pressure is 50 atm, which of the following statements is/are true ?
- I. In a closed container at 154 K and 50 atm, the solid, liquid, and gaseous phases of oxygen are in dynamic equilibrium.
 II. Oxygen can be compressed into a liquid at room temperature.
 III. It can be reasoned that ammonia has a critical temperature above 154 K.
- (A) I is true (B) II and III are true
 (C) III is true (D) I and III are true
- Q.5** In the Van der Waals equation, the purpose of the nb term is to-
- (A) Take into account that gas molecules exert intermolecular attractive forces.
 (B) Take into account that gas molecules have a finite volume.
 (C) Take into account that gas molecules react chemically with each other and the equilibrium constant depends on P and T.
 (D) Take into account Heisenberg's uncertainty principle.
- Q.6** In the Van der Waals equation, the purpose of the n²a / V² term is to-
- (A) Take into account that gas molecules exert intermolecular attractive forces.
 (B) Take into account that gas molecules have a finite volume.
 (C) Take into account that gas molecules react chemically with each other and the equilibrium constant depends on P and T.
 (D) Take into account Heisenberg's uncertainty principle.