GASEOUS STATE

ASSIGNMENTS

OBJECTIVE QUESTIONS

LEVEL – I

Q.1 The temperature of an ideal gas is increased from 140 K to 560 K. If at 140 K the root-mean square velocity of the gas molecules is V, at 560 K it becomes :
(A) 5 V (B) 2 V (C) V/2 (D) V/4

Q.2 If for two gases of molecular weights M_A and M_B at temperature T_A and T_B, $T_A M_B = T_B M_A$, then which property has the same magnitude for both the gases :
(A) density (B) pressure (C) K. E. per mole (D) r.m.s. speed

Q.3 The internal pressure of one mole of a Vander Waal gas is equal to :
(A) zero (B) b^2 (C) $\frac{a}{V^2}$ (D) $b - \frac{a}{RT}$

Q.4 Which of the following gas molecules has the longest mean-free path ?
(A) H_2 (B) N_2 (C) O_2 (D) Cl_2

Q.5 The mass of CO_2 that must be mixed with 20 g of oxygen such that 27 ml of a sample of the resulting mixture contains equal number of molecules of each gas –
(A) 13.75 g (B) 27.5 g (C) 41.25 g (D) 55 g

Q.6 A mixture of hydrogen and oxygen (45 ml) is sparked to form liquid water. The component not in excess reacts completely and 15 ml is left over. (All measurements are made at the same temperature and pressure). The composition by volume in the original mixture of $H_2 : O_2$ is
(A) 4 : 5 (B) 7 : 2
(C) either 4 : 5 or 7 : 2 (D) 2 : 1

Q.7 A balloon filled with ethylene is pricked with a sharp pointed needle and quickly placed in a tank full of hydrogen at the same pressure. After a while the balloon would have :
(A) shrunk (B) enlarged
(C) completely collapsed (D) remain unchanged in size.

Q.8 What percent of a sample of nitrogen must be allowed to escape if its temperature, pressure and volume are to be changed from 273 °C , 3.00 atm , and 1.65 L to 0°C, 0.75 atm and 0.55 L.
(A) 16.67 % (B) 83.33 % (C) 75.00 % (D) 25.00 %

Q.9 In a gaseous mixture at 20°C the partial pressure of the components are, :
H_2 : 150 Torr , CO_2 : 200 Torr , CH_4 : 300 Torr , C_2H_4 : 100 Torr ,
Volume percent of H_2 is :
(A) 26.67 (B) 73.33 (C) 80.00 (D) 20

Q.10 At what temperature will the total K. E. of 0.30 mol of He be the same as the total K.E. of 0.40 mol of Ar at 400 K ?
(A) 533 K (B) 400 K (C) 346 K (D) 300 K

Q.11 A 34.0 litre cylinder contains 212 g of O_2(g) at 27 °C . What mass of O_2 (g) must be released to reduced the pressure to 2.463 atm ?
(A) 103.2 g (B) 108.8 g (C) 100.0 g (D) 32 g

Q.12 At STP, a container has 1 mole of Ar, 2 moles of CO_2, 3 moles of O_2 and 4 moles of N_2. Without changing the total pressure if one mole of O_2 is removed, the partial pressure of O_2 :
(A) is changed by about 26 % (B) is halved
(C) is unchanged (D) changed by 33 %

Q.13 Gas equation PV = nRT is obeyed by :
(A) only isothermal process (B) only adiabatic process
(C) both (A) and (B) (D) none of these

LEVEL – II

Q.1 The time taken for effusion of 32 ml of oxygen will be the same as the time taken for effusion under identical conditions of –
(A) 64 ml of H_2 (B) 50 ml of N_2
(C) 27.3 mol of CO_2 (D) 22.62 ml of SO_2

Q.2 A mixture of methane and ethene in the mole ratio X : Y has a mean molecular weight = 20. What would be the mean molecular weight if the same gases are mixed in the ratio Y : X
(A) 22 (B) 24 (C)20.8 (D) 19

Q.3 Which of the following gases will have the same rate of diffusion under identical conditions?
(i) CO, (ii) CO_2, (iii) N_2O, (iv) N_2, (v) C_2H_4 (vi) C_3H_8
(A) CO,CO_2,C_2H_4 (B) CO_2,C_2H_4,N_2O
(C) C_3H_8,N_2O,CO_2 (D) CO, N_2,C_2H_4,C_3H_8

Q.4 For two gases, A and B with molecular weights M_A and M_B, it is observed that at a certain temperature, T, the mean velocity of A is equal to the root mean squared velocity of B. Thus the mean velocity of A can be made equal to the mean velocity of B, if –
(A) A is at temperature, T, and B at T_1, $T > T_1$
(B) A is lowered to a temperature $T_2 < T$ while B is at T
(C) Both A and B are raised to a higher temperature
(D) Both A and B are lowered in temperature

Q.5 An ideal gas is at a pressure (P) and temperature (T) in a box, which is kept in vacuum within a large container. The wall of the box is punctured. What happens as the gas escape through the hole ?
(A) the temperature falls (B) its temperature rises
(C) its temperature remains the same (D) unpredictable

Q.6 A certain gas is diffused from two different vessels A and B. The vessel A has a circular orifice while vessel B has square orifice of length equal to the radius of the orifice of vessel A. The ratio of the rates of diffusion of the gas form vessel A to that of in vessel B assuming same T & P is :

(A) π (B) $1/\pi$ (C) 1 : 1 (D) 2 : 1

Q.7 Which of the following statements is not true ?

(A) The ratio of the mean speed to the rms speed is independent of the temperature.

(B) The square of the mean speed of the molecules is equal to the mean squared speed at a certain temperature.

(C) Mean kinetic energy of the gas molecules at any given temperature is independent of the mean speed.

(D) The difference between rms speed and mean speed at any temperature for different gases diminishes as larger and yet larger molar masses are considered.

Q.8 Consider the following statements :

The mean free path of gas molecules

A : decreases with increase in concentration

B : increases with decrease in pressure at constant temperature

C : decrease with increase in molecular size

Which of the above statements are correct ?

(A) A and B (B) A and C (C) B and C (D) A, B and C

Q.9 Consider the following statements : The coefficient B in the virial equation of state

$$PV_m = RT\left(1+\frac{B}{V_m}+\frac{C}{V_m^2}+.....\right)$$

A : is independent of temperature

B : is equal to zero at Boyle temperature

C : has the dimension of molar volume

Which of the above statements are correct ?

(A) A and B (B) A and C (C) B and C (D) A, B and C

Q.10 The number of collision of Ar atoms with the walls of their container per unit time –

(A) increases when the temperature decreases

(B) remains the same when CO_2 is added to the container at constant temperature

(C) increases when CO_2 is added to the container at constant temperature

(D) decreases when the average kinetic energy per molecule increases

LEVEL – III

Q.1 Which of the following quantities is the same for all ideal gases at the same temperature?

(A) The kinetic energy of 1 mol (B) the kinetic energy of 1 g

(C) The number of molecules in 1 mol (D) The number of molecules in 1 g

Q.2 The value of the molar gas constant is

(A) 8.3145×10^3 J $(kg\ mol)^{-1}K^{-1}$ (B) 1.987 cal $mol\ K^{-1}$

(C) 0.083145×10^3 dm^3 bar $mol^{-1}\ K^{-1}$ (D) 0.983145 dm^3 bar $mol^{-1}\ K^{-1}$

Q.3 Which of the following statements are correct on the basis of Charles's law?

(A) The volume of an ideal gas can never be zero.
(B) The pressure of an ideal gas can be zero.
(C) At zero pressure, all molecular motion ceases in gas, and its does not exert any pressure on the walls of the container.
(D) It is not possible to attain absolute zero.

Q.4 Which of the following expressions is correct on the basis of the ideal gas equation?

(A) $PV = \frac{N}{N_A} RT$ (B) $PV = Nk_BT$ (C) $PV = \frac{\rho}{w} RT$ (D) $PV = \frac{Mk_BT}{w}$

Q.5 Which of the following statements are correct?
(A) Helium diffuses at a rate 8.65 times as much as CO does.
(B) Helium escapes at a rate 2.65 times as fast as CO does.
(C) Helium escapes at a rate 4 times as fast as CO_2 does.
(D) Helium escapes at a rate 4 times as fast as SO_2 does.

Q.6 According to the kinetic theory of gases.
(A) the pressure exerted by a gas is proportional to the mean square speed of the molecules.
(B) the pressure exerted by a gas is proportional to the root mean square speed of the molecules
(C) the root mean square speed is inversely proportional to the temperature.
(D) the mean translational kinetic energy of the molecule is directly proportional to the absolute temperature.

Q.7 Indicate the correct statement for equal volumes of $N_2(g)$ and $CO_2(g)$ at 298 K and 1 atm.
(A) The average translational KE per molecule is the same for N_2 and CO_2
(B) The rms speed remains constant for both N_2 and CO_2.
(C) The density of N_2 is less than that of CO_2.
(D) The total translational KE of both N_2 and CO_2 is the same.

Q.8 A gas can be easily liquefied
(A) When its inversion temperature equals the Boyle temperature
(B) under reversible adiabatic expansion
(C) under pressure when it is cooled to below the critical temperature
(D) at low pressure and above the critical temperature.

Q.9 Which of the following is correct for critical temperature?
(A) It is the highest temperature at which liquid and vapour can coexist.
(B) Beyond this temperature, there is no distinction between the two phases and a gas cannot be liquefied by compression.
(C) At this temperature, the surface tension of the system is zero.
(D) At this temperature, the gas and the liquid phases have different critical densities.

Q.10 According to Charles's law :

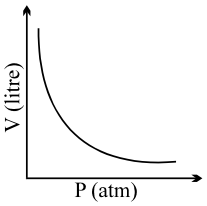
(A) $V \propto \frac{1}{T}$ (B) $\left(\frac{dV}{dT}\right)_P = K$ (C) $\left(\frac{dT}{dV}\right)_P = K$ (D) $\left(\frac{1}{T} - \frac{V}{T^2}\right) = 0$

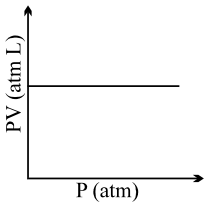
Q.11 The temperature of ideal gas can be increased by
(A) decreasing the volume and pressure but keeping the amount constant
(B) increasing the pressure but keeping the volume and amount constant
(C) decreasing the amount but keeping the volume and pressure constant
(D) increasing the amount but keeping the volume and pressure constant

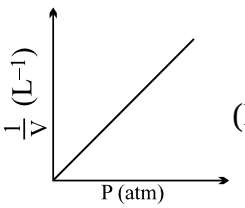
Q.12 Four gas balloons A, B, C, D of equal volumes containing H_2, H_2O, CO, CO_2 respectively were pricked with needle and immersed in a tank containing CO_2. Which of them will shrink after some time.
(A) A (B) B (C) C (D) Both A and D

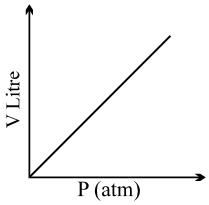
Q.13 For a gaseous system, the pressure can be increased by
(A) increasing the volume of container but keeping the amount and temperature constant
(B) increasing the amount of gas at constant temperature and volume
(C) decreasing the volume of container but keeping the amount and temperature constant
(D) decreasing temperature but keeping amount and volume constant

Q.14 Boyle's law is represented by -

(A) 

(B) 

(C) 

(D) 

Q.15 Three gases of densities A(0.82), B(0.25), C(0.51) are enclosed in a vessel of 4L capacity. Pick up the correct statement :

I. Gas A will tend to lie at the bottom
II. The number of atoms of various gases A, B, C are same
III. The gases will diffuse to form homogeneous mixture.
IV. The average kinetic energy of each gas is same.

(A) I , IV (B) only III (C) III , IV (D) II, III

Q.16 Which of the following pair of gases will have same rate of diffusion under similar condition

(A) H_2 & He (B) CO_2 & N_2O (C) CO & C_2H_4 (D) NO & CO

LEVEL – IV

1. Match the following

	List I		**List II**
(A)	U_{rms}/U_{av}	(i)	1.22
(B)	U_{av}/U_{mp}	(ii)	1.13
(C)	U_{rms}/U_{mp}	(iii)	1.08

(a) (A)-(iii), (B)-(ii), (C)-(i) (b) (A)-(i), (B)-(ii), (C)-(iii)
(c) (A)-(iii), (B)-(i), (C)-(ii) (d) (A)-(ii), (B)-(iii), (C)-(i)

2. Vander Waal's equation for

	List-I		**List-II**
(A)	High pressure	(i)	PV = RT + Pb
(B)	Low pressure	(ii)	PV = RT –a/V
(C)	Force of attraction is negligible	(iii)	PV = RT + a/V
(D)	Volume of molecules is negligible	(iv)	$\left(P + \frac{a}{V^2}\right)(V - b) = RT$

(a) (A)-(i), (B)-(ii), (C)-(i), (D)-(ii) (b) (A)-(i), (B)-(ii), (C)-(iii), (D)-(iv)
(c) (A)-(iv), (B)-(iii), (C)-ii, (D)-i (d) (A)-(iv), (B)-(ii), (C)-(iii), (D)-(i)

3. Match the following

	List I		**List II**
(A)	1 Pa	(i)	14.7 *l* b/In^2(Psi)
(B)	760 torr	(ii)	(^{o}F) – 32
(C)	10.33 mm of H_2O	(iii)	10 dyne/cm^2
(D)	1.8 (^{o}C)	(iv)	1.01325 bar

(a) (A)-(iii), (B)-(i), (iii) , (C)-(ii), (iv) (D)-(ii)
(b) (A)-(i), (B)-(ii), (iv) , (C)-(i), (iv) (D)-(iii)
(c) (A)-(i), (B)-(iii), (iv) , (C)-(i), (iv) (D)-(ii)
(d) (A)-(iii), (B)-(i), (iv) , (C)-(i), (iv) (D)-(ii)

4. Match the column

	Column I		**Column II**
	Measurement of pressure		**Device used**
(i)	Pressure of gas is less than atm pressure	(A)	Sphygmomanometer

(ii)	Pressure of gas is more than atm pressure	(B)	Barometer
(iii)	Absolute pressure of gas	(C)	open arm manometer
(iv)	Atmospheric pressure	(D)	closed arm manometer

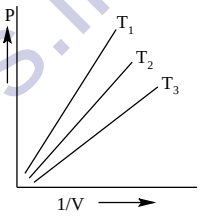
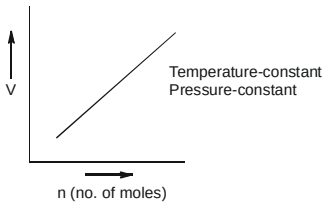
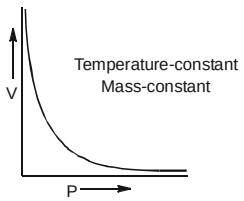
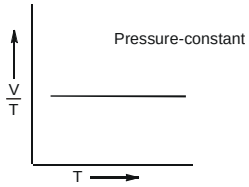
(a) (i) - CD; (ii) - CD; (iii)-D ; (iv) - B
(b) (i) - AD; (ii) - BC; (iii)-A ; (iv) - B
(c) (i) - AC; (ii) - CD; (iii)-A ; (iv) -D
(d) (i) - AD; (ii) - BC; (iii)-B ; (iv) - A

5. Match the column

	Column I		**Column II**
(i)	Boyle's law	(A)	Mass = constant
(ii)	Charle's law	(B)	Pressure = constant
(iii)	Gaylussac's law	(C)	Temperature = constant
(iv)	Avogadro's law	(D)	Volum = constant

(a) (i) - A, C ; (ii) - A, D ; (iii) - A,B ; (iv) - B, C
(b) (i)- B, D ; (ii) - A, C ; (iii) - A, C ; (iv) - A, B, C, D
(c) (i)- A, D ; (ii) - D, C ; (iii) - A, C ; (iv) - A, C
(d) (i)- B, C ; (ii) - C, D ; (iii) - D, C ; (iv) - A, D

6. Match the column

	Column I		**Column II**
(i)	$T_1 > T_2 > T_3$	(A)	
(ii)	Charle's Law	(B)	
(iii)	Boyle's law	(C)	
(iv)	Avogadro's law	(D)	

(a) (i) - CD; (ii) - CD; (iii)-D ; (iv) - B
(b) (i) - AD; (ii) - BC; (iii)-A ; (iv) - B
(c) (i) - AC; (ii) - CD; (iii)-A ; (iv) -D
(d) (i) - A; (ii) - D; (iii) - A,C ; (iv) - B

7. Match the column

Column I	**Column II**

(i)	$Z < \frac{PV}{nRT}$	(A)	Positive deviation
(ii)	$Z > \frac{PV}{nRT}$	(B)	negative deviation
(iii)	H_2, He	(C)	Small size of atom
(iv)	N_2, CO_2	(D)	molecular attraction

(a) (i) - A, D ; (ii) - C, D ; (iii) - A,B ; (iv) - B, C
(b) (i)- B, D ; (ii) - A, C ; (iii) - A, C ; (iv) - A, B, C, D
(c) (i)- A, D ; (ii) - D, C ; (iii) - A, C ; (iv) - A, C
(d) (i)- B, C ; (ii) - C, D ; (iii) - D, C ; (iv) - A, D

SUBJECTIVE QUESTIONS

LEVEL – I

Q.1 The ratio of rate of diffusion of gases A and B is 1 : 4. If the ratio of their masses present in the initial mixture is 2 : 3, calculate the ratio of their mole fraction.

Q.2 400 moles of vander Walls' gas having b = 0.02 L mol^{-1} are contained in a 1000 litre vessel. The temperature and pressure of the gas are 400 K and 90 atm respectively. Calculate the pressure of the gas at 700 K.

Q.3 3.6 g of CO_2 gas injected into a bulb of internal volume 8 litre at pressure and temperature TK. When the bulb was then placed in a thermostate maintained at (T + 115 K). 0.6 g of the gas was let off to keep the original pressure. Find the value of P and T.

Q.4 At 20°C, two balloons of equal volume and porosity are filled to pressure of 2 atm, one with 14 kg N_2 and other with 1 kg of H_2. The N_2 balloon leaks to a pressure of 1/2 atm in 1 hr. How long will it take for H_2 balloon to reach a pressure of 1/2 atm ?

Q.5 Find the temperature at which 3 mole of SO_2 obeying vander Wall's equation occupies a volume of 10 litre at a pressure of 15 atm. [a = 6.71 atm lit^2 mol^{-2}, b = 0.0564 lit mol^{-1}]

Q.6 Vander Waal's constant b for a gas is 4.2×10^{-2} litre mol^{-1}. How close the nuclei of the two molecules come together ?

Q.7 Radius of a spherical molecule of a gas is 2×10^{-8} cm. Calculate :
(a) Co-volume per molecule **(b)** Co-volume per mole
(c) Critical volume

Q.8 Relative humidity is defined as the ratio of partial pressure of water in air at a given temperature to the vapour pressure of water at that temperature. Calculate the mass of water per litre air at:
(a) 20 ºC and 45 % relative humidity **(b)** 0 °C and 95% relative humidity
(c) Discuss whether temperature or relative humidity has the greater effect on the mass of water vapour in air.

Given $P^{\circ}_{H_2O}$ = 17.5 torr at 20°C and 4.58 torr at 0ºC

Q.9 For 10 minutes each, at 27ºC, from two identical holes nitrogen and an unknown gas are leaked into a common vessel of 3 litre capacity . The resulting pressure is 4.18 bar and the mixture contains 0.4 mole of nitrogen. What is the molar mass of the unknown gas ?

Q.10 The pressure in a vessel that contained pure oxygen dropped from 2000 torr to 1500 torr in 55 minute as the oxygen leaked through a small hole into a vacuum. When the same vessel is filled with another gas, the pressure dropped from 2000 torr to 1500 torr in 85 minute . What is the molecular weight of gas .

LEVEL – II

Q.1 How much water vapour is contained in a cubic room of 4 m along an edge if the relative humidity is 50 % and the temperature is 27 °C ? The vapour pressure of water at 27 °C is 26.7 torr. [The relative humidity expresses the partial pressure of water as a per cent of water vapour pressure]

Q.2 One molecule of haemoglobin will combine with four O_2 molecules. If 1.0 g of haemoglobin combines with 1.53 mL of oxygen at body temperature (37°C) and a pressure of 743 torr, what is the molar mass of haemoglobin ?

Q.3 A 1.5 litre sample of a gas having density 1.25 kg/m^3 at 1.0 atm and 0°C was compressed to 575 atm resulting a gas volume 3.92 cm^3 in violation of Boyle's law. What is the final density of this gas ?

Q.4 A 10.0 m^3 tank is constructed to store LNG (liquefied natural gas, CH_4) at –164°C and 1 atm pressure, under which its density is 415 kg/m^3. Calculate the volume of storage tank capable of holding the same mass of LNG as a gas at 20°C and 1.0 atm pressure.

Q.5 The compressibility factor for N_2 at 223 K and 81.06 MPa is 1.95 and at 373 K and 20.265 MPa is 1.10. If a certain mass of N_2 occupies 1 litre at 223 K and 81.06 MPa, what would be its volume at 373 K and 20.265 MPa.

Q.6 A vessel contains 7.1 g chlorine gas at pressure P and temperature TK. On heating the vessel to 30° higher temperature, 246 ml of chlorine at 1 atm and 27°C is taken out to maintain same pressure in vessel. Calculate,

(a) The original temperature.

(b) If the gas is not allowed to escape out, the pressure increase by 0.11 atm. Calculate the volume of vessel and initial pressure.

Q.7 A jar contains a gas and few drops of water at TK. The pressure in the jar is 830 mm of Hg. The temperature of the jar is reduced to 99%. The vapour pressure of water at two temperatures are 30 and 25 mm of Hg respectively. Calculate the pressure in jar.

Q.8 One litre flask contain air, water vapour and a small amount of liquid water at a pressure of 200 mm Hg. If this is connected to another one litre evacuated flask, what will be the final

pressure of the gas mixture at equilibrium ? Assume the temperature to be 50°C. Aqueous tension at 50°C = 93 mm Hg.

Q.9 An evacuated bulb of unknown volume is filled with a sample of H_2 gas at a temperature T. The pressure of the gas in the bulb is 756 mm Hg. A portion of the H_2 gas is transferred to a different flask and found to occupy a volume of 40.0 mL at 1.00 atm and the same temperature T. The pressure of the H_2 gas remaining in the original bulb drops to 625 mm Hg at the same temperature T. Assuming H_2 is an ideal gas, what is the volume of the bulb?

Q.10 Two flasks of equal volume connected by a narrow tube (of negligible volume) are at 27°C and contain 0.70 mole of H_2 at 0.5 atm. One of the flask is then immersed into a bath kept at 127 °C, while the other remains at 27°C. Calculate the final pressure and the number of mole of H_2 in each flask.

Q.11 A container holds 3 litre of $N_2(g)$ and $H_2O(l)$ at 29°C. The pressure is found to be 1 atm. The water in container is instantaneously electrolysed to give H_2 and O_2 following the reaction , $H_2O(l) \longrightarrow H_2(g) + \frac{1}{2}O_2(g)$. At the end of electrolysis the pressure was found to be 1.86 atm. Calculate the amount of water present in the container if the aqueous tension of water at 29°C is 0.04 atm.

Q.12 A highly sealed 25.0 litre acetone drum was found to have 15.4 litre acetone (l) at 780 mm Hg pressure and 18°C. Suddenly during transportation the drum was dented and its internal volume was found to decrease by 4.6 litre. If vapour pressure of acetone at 18°C is 400 mm of Hg, calculate the pressure inside the drum after denting.

LEVEL – III

NCERT TEXT BOOK EXERCISE

1. What will be the minimum pressure required to compress 500 dm^3 of air at 1 bar to 200 dm^3 at 30 ºC ?

2. A vessel of 120 mL capacity contains a certain amount of gas at 35ºC and 1.2 bar pressure. The gas is transferred to another vessel of volume 180 mL at 35 ºC. What would be its pressure ?

3. Using the equation of state PV = nRT; show that at a given temperature density of a gas is proportional to gas pressure P.

4. At 0ºC; the density of a gaseous oxide at 2 bar is same as that of nitrogen 5 bar. What is the molecular mass of the oxide?

5. Pressure of 1 g of an ideal gas A at 27ºC is found to be 2 bar when 2 g of another ideal gas B is introduced in the same flask at same temperature the pressure becomes 3 bar. Find a relationship between their molecular masses.

6. The drain cleaner, Drainex contains small bits of aluminium which react with caustic soda to produce hydrogen. What volume of hydrogen at 20ºC and one bar will be released when 0.15g of aluminum reacts?

7. What will the pressure exerted by a mixture of 3.2 g of methane and 4.4g of carbon dioxide contained in a dm^3 flask at 27ºC?

8. What will be the pressure of the gas mixture when 0.5L of H_2 at 0.8 bar and 2.0L of oxygen at 0.7 bar are introduced in at I L vessel at 27ºC?

9. Density of a gas is found to be 5.4g/dm^3 at 27ºC at 2 bar pressure. What will be its density at STP ?

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 ?

11. A student forgot to add the reaction mixture to the round bottomed flask at 27ºC but put it on the flame. After a lapse of time, he realised his mistake, using a pyrometer he found the temperature of the flask was 477ºC. What fraction of air would have been expelled out?

12. Calculate the temperature of 4.0 moles of a gas occupying 5 dm^3 at 3.23 bar.

13. Calculate the total number of electrons present in 1.4 g of nitrogen gas.

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

15. Calculate the total pressure in a mixture of 8 g of oxygen and 4 g of hydrogen confined in a vessel of 1 dm^3 at 27ºC. R = 0.083 bar dm^3 K^{-1}mol^{-1}.

16. Pay load is defined as the difference between the mass of displaced air and the mass of the balloon . Calculate the pay load when a balloon of radius 10m, mass 100kg is filled with helium at 1.66 at 27ºC. (density of air = 1.2 kg m^{-3} and R = 0.083 bar dm^{3}K^{-1}mol^{-1})

17. Calculate the volume occupied by 8.8 g of CO_2 at 31.1ºC and 1 bar pressure .

18. 2.9 g of a gas at 95ºC occupied the same volume as 0.184 g of hydrogen at 17ºC, at the same pressure, What is the molar mass of the gas?

19. Through the two ends of a glass tube of length 200 cm hydrogen chlorided gas and ammonia are allowed to enter. At what distance ammonium chloride will first appear ?

20. For 10 minutes each , at 27ºC, from two identical holes nitrogen and an unknown gas are leaked into a common vessel of 3L capacity. The resulting pressure is 4.18 bar and the mixture contains 0.4 mol of nitrogen. What is the molar mass of the unknown gas?

21. Equal volumes of two gases A and B diffuse through a porous pot in 20 and 10 seconds respectively. If the molar mass of A be 80, find the molar mass of B.

22. Calculate the average kinetic energy of 32 g methane molecules at 27ºC.

23. A mixture of hydrogen and oxygen at one bar pressure contains 20 % by weight of hydrogen. Calculate the partial pressure of hydrogen.

24. What would be the SI unit for the quantity PV^2T^2/n.

25. In terms of Charles'law explain why –273ºC is the lowest possible temperature.

26. Explain the physical significance of van der Waals parameters.

27. Critical temperature for carbon dioxide and methane are 31.1ºC and –81.9ºC respectively. Which of these has stronger intermolecular forces and why?

28. A manometer is connected to a gas containing bulb. Then open arm reads 43.7cm where as the arm connected to the bulb reads 15.6 cm. It the barometric pressure is 743 mm mercury. What is the pressure of gas in bar.

LEVEL – IV

[IIT-JEE FLASH BACK]

1981

Q.1 Equal weights of methane and oxygen are mixed in an empty container at 25ºC. The fraction of the total pressure exerted by oxygen is

(A) $\frac{1}{3}$ (B) $\frac{1}{2}$ (C) $\frac{2}{3}$ (D) $\frac{1}{3}\times\frac{273}{298}$

Q.2 The temperature at which a real gas obeys the ideal gas laws over a wide range of pressure is

(A) critical temperature (B) Boyle temperature
(C) inversion temperature (D) reduced temperature

Q.3 The ratio of root mean square velocity to average velocity of a gas molecule at a particularly temperature is

(A) 1.086 : 1 (B) 1 : 1.086 (C) 2 : 1.086 (D) 1.086 : 2

Q.4 The pressure in a bulb dropped from 2000 to 1500 mm of mercury in 47 minutes when the contained oxygen leaked through a small hole. The bulb was then evacuated. A mixture of oxygen and another gas of molecular weight 79 in the molar ratio of 1 : 1 at a total pressure of 4000 mm of mercury was introduced. Find the molar ratio of the two gases remaining in the bulb after a period of 74 minutes.

1982

Q.5 Helium atom is two times heavier than a hydrogen molecule. At 298 K, the average kinetics energy of a helium atom is

(A) two times that of a hydrogen molecule (B) same as that of a hydrogen molecule
(C) four times that of a hydrogen molecule (D) half that of a hydrogen molecule

Q.6 At room temperature, ammonia gas at 1 atm pressure and hydrogen chloride gas at P atm pressure are allowed to effuse through identical pin holes from opposite ends of a glass tuebe of one metre length and of uniform cross-section. Ammonium chloride is first formed at a distance

of 60 cm from the end through which HCl gas is sent in. What is the value of P.

Q.7 Calculate the average of kinetic energy, in joules of the molecules in 8.0 g of methane at 27ºC.

1983

Q.8 Oxygen is present in 1 litre flask at a pressure 7.6×10^{-10} mm of Hg. Calculate the number of oxygen molecules in the flask at 0ºC.

Q.9 When 2 gm of a gas A is introduced into an evaluated flask kept at 25ºC, the pressure is found to be one atmosphere. If 3 gm of another gas B is then added to the same flask, the total pressure becomes 1.5 atm. Assuming ideal gas behaviour, calculate the ratio of the molecular weights $M_A : M_B$.

1984

Q.10 The total energy of one mole of an ideal monatomic gas at 27ºC is _____ calories.

Q.11 $C_p - C_v$ for an ideal gas is _____ .

Q.12 Equal weights of methane and by hydrogen are mixed in an empty container at 25ºC. The fraction of the total pressure exerted by hydrogen is

(A) $\frac{1}{2}$ (B) $\frac{8}{9}$ (C) $\frac{1}{9}$ (D) $\frac{16}{17}$

Q.13 When an ideal gas undergoes unrestrained expansion, no cooling occurs because the molecules
(A) are above the inversion temperature (B) exert no attractive forces on each other
(C) do work equal to loss in kinetic energy (D) collide without loss of energy

Q.14 'Equal volumes of gases contain equal number of atoms', is true at what conditions.

1985

Q.15 Rate of diffusion of a gas is :
(A) directly proportional to its density
(B) directly proportional to its molecular weight
(C) directly proportional to the square root of its molecular weight
(D) inversely proportional to the square root of its molecular weight

Q.16 Kinetic energy of a molecule is zero at 0 ºC . **[True/False]**

Q.17 A gas in a closed container will exert much high pressure due to gravity at the bottom than at the top. **[True/False]**

Q.18 Calculate the root mean square velocity of ozone kept in a closed vessel at 20ºC and 82 cm mercury pressure.

1986

Q.19 The average velocity of an ideal gas molecule at 27ºC is 0.3 m/sec. The average velocity at 927ºC will be
(A) 0.6 m/sec (B) 0.3 m/sec (C) 0.9 m/sec (D) 3.0 m/sec

Q.20 The rate of diffusion of gas is _____ proportional to both _____ and square root of molecular mass.

Q.21 If a gas is expanded at constant temperature :
(A) the pressure decreases

(B) the kinetic energy of the molecules remain the same
(C) the kinetic energy of the molecules decreases
(D) the number of molecules of the gas increases

1987

Q.22 The value of PV for 5.6 litre of an ideal gas is _____ RT at N T P.

Q.23 A spherical balloon of 21 cm diameter is to be filled up with hydrogen at NTP, from a cylinder containing the gas at 20 atm at 27^0C. If the cylinder can hold 2.82 litre of water, calculate the number of balloons that can be filled up.

1988

Q.24 In Vander Waals equation of state for a non ideal gas, term that accounts for intermolecular forces is:

(A) (v - b) (B) RT (C) $\left(P + \frac{a}{v^2}\right)$ (D) $(RT)^{-1}$

Q.25 A bottle of dry NH_3 and a bottle of dry HCl connected through a long tube are opened simultaneously at both ends, the white ammonium chloride ring first formed will be :
(A) at the centre of the tube (B) near the HCl bottle
(C) near the NH_3 bottle (D) throughout the length of tube

1989

Q.26 n-butane is produced by the monobromination of ethane followed by the Wurtz reaction. Calculate the volume of ethane at NTP required to produce 55 g n - butane, if the bromination takes place with 90% yield and the Wurtz reaction with 85% yield.

Q.27 The values of Vander Waals constant 'a' for the gases O_2, N_2, NH_3, & CH_4 are 1.36, 1.39, 4.17, 2.253 $2\overline{)212}$ atm $mole^{-2}$ respectively. The gas which can most easily be liquified is :
(A) O_2 (B) N_2 (C) NH_3 (D) CH_4

Q.28 Eight gm each of oxygen and hydrogen at 27^0C will have the total kinetic energy in the ratio of _____.

1990

Q.29 The density of neon will be highest at :
(A) S T P (B) 0^0 C, 2 atm (C) 273^0 C, 1 atm (D) 273^0 C, 2 atm

Q.30 The rate of diffusion of methane at a given temperature is twice that of gas X. The molecular weight of X is :
(A) 64.0 (B) 32.0 (C) 4.0 (D) 8.0

Q.31 The average velocity at T_1 K and the most probable velocity of T_2 K of CO_2 gas is 9.0×10^4 cm/s. Calculate the value of T_1 and T_2.

1991

Q.32 According to kinetic theory of gases :
(A) the pressure exerted by the gas is proportional to the mean velocity of the molecule
(B) the pressure exerted by the gas is proportional to the r.m.s. velocity of the molecule
(C) the r.m.s. velocity of the molecule is inveresly proportional to the temperature
(D) the mean translational kinetic energy of the molecule is proportional to the absolute temperature.

Q.33 Calculate the volume occupied by 5.0 g of acetylene gas at 50^0C and 740 mm pressure.

1992

Q.34 At constant volume, for a fixed number of moles of a gas the pressure of the gas increase with rise in temperature due to:

(A) increase in average molecular speed
(B) increased rate of collisions amongst molecules
(C) increase in molecular attraction
(D) decrease in mean free path

Q.35 At 27^0C, hydrogen is leaked through a tiny hole into a vessel for 20 minutes. Another unknown gas at the same temperature and pressure as that of H_2 is leaked through the same hole for 20 minutes . After the effusion of the gases the mixture exerts a pressure of 6 atm. The hydrogen content of the mixture is 0.7 mole . If the volume of the container is 3 litre , what is molecular weight of unknown gas.

Q.36 A 2.0 g sample of a mixture containing sodium carbonate, sodium bicarbonate and sodium sulphate is gently heated till the evolution of CO_2 ceases. The volume of CO_2 at 750 mm Hg pressure and at 298 k is 123.9 ml. A 1.5 g of the same sample requires 150 ml of $\frac{M}{10}$ HCl for complete neutralisation. Calculate the percentage composition of the mixture.

Q.37 At room temperature the following reactions proceed nearly to completion.

$$2\ NO + O_2 \longrightarrow 2\ NO_2 \longrightarrow N_2O_4\ .$$

The dimer N_2O_4, solidifies at 262 K. A 250 ml flask and a 100 ml flask are separated by a stopcock . At 300 K, the NO in the larger flask exerts a pressure of 1.053 atm and smaller one contains oxygen at 0.789 atm. The gases are mixed by opening the stopcock and after the end of the reaction the flasks are cooled to 220 K. Neglecting the vapour pressure of the dimer, find out the pressure and composition of the gas remaining at 220 K

[Assuming the gases to behave ideally]

1993

Q.38 In the Vander Waals equation $\left(P + \frac{n^2 a}{V^2}\right)(V - nb) = nRT$, the constant 'a' reflects the actual volume of the gas molecules. **[True/False]**

Q.39 Equal weights of ethane and hydrogen are mixed in an empty container at 25^0C. The fraction of the total pressure exerted by hydrogen is :

(A) 1 : 2 (B) 1 : 1 (C) 1 : 16 (D) 15 : 16

Q.40 A gas bulb of 1 litre capacity contains 2.0×10^{21} molecules of nitrogen exerting a pressure of 7.57×10^3 N m^{-2}. Calculate the r.m.s speed and the temperature of the gas molecules. If the ratio of the most probable speed to the r.m.s. speed is 0.82. Calculate the most probable speed for these molecules at this temperature.

1994

Q.41 A 4 : 1 molar mixture of He & CH_4 is contained in a vessel at 20 bar pressure . Due to a hole in the vessel the gas mixture leaks out. What is the composition of the mixture effusing out initially.

Q.42 An LPG cylinder weighs 14.8 kg when empty. When full, it weighs 29.0 kg and shows a pressure of 2.5 atm. In the course of use at 27^0C, the weight of the full cylinder reduced to 23.2 kg. Find out the volume of the gas in cubic meters used up at the normal usage conditions and the final pressure inside the cylinder. Assume LPG to be n-butane with normal boiling point of 0^oC.

Q.43 A balloon of diameter 20 m weighs 100 kg. Calculate payload if it is filled with He at 1 atm and 27^0C. Density of air = 1.2 kg/m^3 .

1995

Q.44 Longest mean free path stands for :

(A) H_2 (B) N_2 (C) O_2 (D) Cl_2

Q.45 A mixture of ethane and ethene occupies 40 litre at 1 atm and 400 K. The mixture reacts completely with 130 g of O_2 to produce CO_2 & H_2O. Assuming ideal gas behaviour. Calculate the mole fractions of ethane and ethene in the mixture.

Q.46 Arrange the vander Waals constant for the gases :

(i)	C_6H_6(g)	a.	0.217
(ii)	$C_6H_5.CH_3$(g)	b.	5.464
(iii)	Ne(g)	c.	18.000
(iv)	H_2O	d.	24.060

(A) i-a, ii-d, iii-c, iv-b (B) i-d, ii-a, iii-b, iv-c

(C) i-c, ii-d, iii-a , iv-b (D) i-b, ii-c, iii-a, iv-d

Q.47 The composition of the equilibrium mixture ($Cl_2 \Leftrightarrow 2$ Cl) which is attained at 1200^0C is determined by measuring the rate of effusion through a pin hole . It is observed that at 1.8 mm Hg pressure , the mixture effuses 1.16 times as fast as Kr effuses under the same conditions. Calculate the fraction of chlorine molecules dissociated into atoms.

Q.48 An cylinder contains helium at a pressure of 250 kPa & 300 K. The cylinder can withstand a pressure of 1×10^6 pa. The room in which cylinder is placed catches fire. Predict weather the cylinder will blow up before it melts or not. [melting point of cylinder = 1800 k]

Q.49 A 20.0 cm^3 mixture of CO, CH_4 and He gases is exploded by an electric discharge at room temperature with excess of oxygen. The volume contraction is found to be 13.0 cm^3. A further contraction of 14.0 cm^3 occurs when the residual gas is treated with KOH solution. Find out the composition of the gaseous mixture in terms of volume percentage.

1996

Q.50 A mixture of ideal gases is cooled up to liquid He temperature (4.22 K) to form an ideal solution. Is this statement is True or False. Justify your answer in not more than two lines.

Q.51 The ratio between the r.m.s. velocity of H_2 at 50 K and that of O_2 at 800 K is :

(A) 4 (B) 2 (C) 1 (D) 1/4’

Q.52 X ml of H_2 gas effuses through a hole in a container in 5 sec. The time taken for the effusion of the same volume of the gas specified below under identicial conditions is :

(A) 10 sec. , He (B) 20 sec. , O_2 (C) 25 sec. , CO (D) 55 sec. , CO_2

Q.53 One mole of N_2O_4 (g) at 300 K is kept in a closed container under one atm. It is heated to 600 K when 20 % by mass of N_2O_4 (g) decomposes to NO_2 (g) The resultant pressure is :

(A) 1.2 atm (B) 2.4 atm (C) 2.0 atm (D) 1.0 atm

1997

Q.54 The compressibility factor for an ideal gas is
(A) 1.5 (B) 1.0 (C) 2.0 (D) ∞

Q.55 The absolute temperature of an ideal gas is _____ to/than the average kinetic energy of the gas molecules.

Q.56 One way of writing the equation for state for real gases is ,

$$P\overline{V} = RT\left[1+\frac{B}{\overline{V}}+.....\right]$$ where B is a constant.

Derive an approximate expression for 'B' in terms of Vander Waals constant 'a' & 'b'.

Q.57 Calculate the total pressure in a 10 litre cylinder which contains 0.4 g He, 1.6 g oxygen and 1.4g of nitrogen at 27°C. Also calculate the partial pressure of He gas in the cylinder. Assume ideal behaviours for gases.

1998

Q.58 Read the following statement and explanation and answer as per the options given below :
(1) Both (A) and (R) are correct and (R) is the correct explanation of (A)
(2) Both (A) and (R) are correct but (R) is not the correct explanation of (A)
(3) (A) is correct but (R) is incorrect
(4) (A) is incorrect but (R) is correct
Assertion : The value of vander Waal's constant 'a' is larger for ammonia than for nitrogen.
Reason : Hydrogen bonding is present in ammonia.
(A) 1 (B) 2 (C) 3 (D) 4

Q.59 According to Graham's law, at a given temperature the ratio of the rates of diffusion $\frac{r_A}{r_B}$ of gases A and B is given by :

(A) $\frac{P_A}{P_B}\left(\frac{M_A}{M_B}\right)^{1/2}$ (B) $\left(\frac{M_A}{M_B}\right)\left(\frac{P_A}{P_B}\right)^{1/2}$ (C) $\frac{P_A}{P_B}\left(\frac{M_B}{M_A}\right)^{1/2}$ (D) $\frac{M_A}{M_B}\left(\frac{P_B}{P_A}\right)^{1/2}$

Q.60 An evacuated glass vessel weighs 50.0 g when empty. 148.0 gm when filled with a liquid of density 0.98 g/ml and 50.5 g when filled with an ideal gas at 760 mm Hg at 300 k. Determine the molecular weight of the gas.

Q.61 Using Vander Waals equation, calculate the constant "a" when 2 moles of a gas confined in a 4 litre flask exerts a pressure of 11.0 atm at a temperature of 300 K. The value of "b" is 0.05 litre mol^{-1}.

Q.62 The degree of dissociation is 0.4 at 400 K and 1.0 atm for the gaseous reaction , $PCl_5 \rightleftharpoons PCl_3 + Cl_2$. Assuming ideal behaviour of all gases, calculate the density of equilibrium mixture at 400 K and 1.0 atmosphere.

Q.63 For the reaction, $N_2O_5(g) \longrightarrow 2NO_2(g) + 0.5O_2(g)$, calculate the mole fraction of $N_2O_5(g)$ decomposed at a constant volume and temperature, if the initial pressure is 600 mm Hg and the pressure at any time is 960 mm Hg. Assume ideal gas behaviour.

1999

Q.64 The pressure exerted by 12 g of an ideal gas at temperature t°C in a vessel of volume V is one atm. When the temperature is increased by 10 degrees at the same volume , the pressure

increases by 10 %. Calculate the temperature 't' and volume 'V'.
[molecular weight of gas = 120]

Q.65 One mole of N_2 gas at 0.8 atm takes 38 sec to diffuse through a pin hole. Whereas one mole of an unknown compound of Xenon with F at 1.6 atm takes 57 sec. to diffuse through the same hole . Calculate the molecular formula of the compound.

Q.66 A gas will approach ideal behaviour at :
(A) low temperature and low pressure (B) low temperature and high pressure
(C) low pressure and high temperature (D) high temperature and high pressure

2000

Q.67 The compressibility of a gas is less than unity at STP. Therefore,
(A) $V_m > 22.4$ litres (B) $V_m < 22.4$ litres (C) $V_m = 22.4$ litre (D) $V_m = 44.8$ litres

Q.68 Read the following statement and explanation and answer as per the options given below :
(1) Both (A) and (R) are correct and (R) is the correct explanation of (A)
(2) Both (A) and (R) are correct but (R) is not the correct explanation of (A)
(3) (A) is correct but (R) is incorrect
(4) (A) is incorrect but (R) is correct
Assertion : The pressure of a fixed amount of an ideal gas is proportional to its temperature.
Reason : Frequency of collision and their impact both increase in proportional to the square root of temperature.
(A) 1 (B) 2 (C) 3 (D) 4

Q.69 The r.m.s. velocity of hydrogen is $\sqrt{7}$ times the r.m.s. velocity of nitrogen . If T is the temperature of the gas :
(A) $T(H_2) = T(N_2)$ (B) $T(H_2) > T(N_2)$
(C) $T(H_2) < T(N_2)$ (D) $T(H_2) = \sqrt{7}\ T(N_2)$

Q.70 The pressure of a fixed amount of an ideal gas is proportional to its temperature .
[True/False]

Q.71 Frequency of collision and their impact both increase in proportional to the square root of temperature. **[True/False]**

Q.72 Calculate the pressure exerted by one mole of CO_2 gas at 273 K, if the Vander Waals constant a = 3.592 dm^6 atm mol^{-2}. Assume that the volume occupied by CO_2 molecules is negligible.

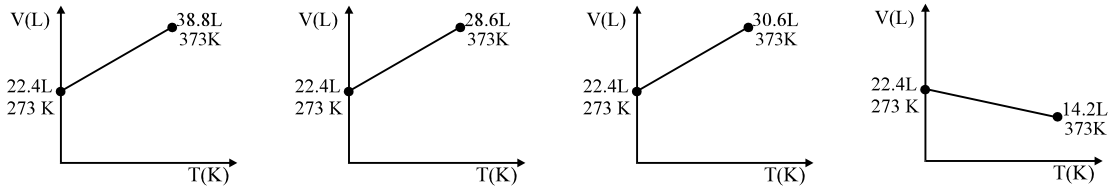
2001

Q.73 The root mean square velocity of an ideal gas at constant pressure varies with density as :
(A) d^2 (B) d (C) $d^{1/2}$ (D) $1/d^{1/2}$

Q.74 The compression factor (compressibility factor) for one mole of a Vander Waals gas at 0°C and 100 atmosphere pressure is found to be 0.5. Assuming that the volume of a gas molecule is negligible, calculate the vander waals constant 'a'.

2002

Q.75 Which one of the following V, T plots represents the behaviour of one mole of an ideal gas at one atm?



(A) (B) (C) (D)

Q.76 The density of the vapour of a substance at 1 atm pressure and 500 K is 0.36 Kgm^{-3}. The vapour effuses through a small hole at a rate of 1.33 times faster than oxygen under the same condition.

(a) Determine :

(i) mol. wt. ; **(ii)** molar volume ; **(iii)** compression factor (z) of the vapour

(iv) which forces among the same molecules are dominating, the attractive or the repulsive

(b) If the vapour behaves ideally at 1000 K, determine the average translation K.E. of a molecule.

2003

Q.77 The average velocity of gas molecules is 400 m/sec. Calculate its (rms) velocity at the same temperature.

Q.78 C_v value of He is always 3R/2 but C_v value of H_2 is 3R/2 at low temperature and 5R/2 at moderate temperature and more than 5R/2 at higher temperature explain in two to three lines.

Q.79 Positive deviation from ideal behaviour takes place because of –

(A) molecular interaction between atoms and $\frac{PV}{nRT} > 1$

(B) molecular interaction between atoms and $\frac{PV}{nRT} < 1$

(C) finite size of atoms and $\frac{PV}{nRT} > 1$ (D) finite size of atoms and $\frac{PV}{nRT} < 1$

2004

Q.80 U_{rms} of a monoatomic gas whose molar kinetic energy is E and its molar mass is M –

(A) $\sqrt{\frac{3E}{2M}}$ (B) $\sqrt{\frac{2E}{M}}$ (C) $\sqrt{\frac{2M}{3E}}$ (D) none of these

Q.81 A graph is plotted between PV_m along Y-axis and P along X-axis, where V_m is the molar volume of a real gas. Find the intercept along Y-axis.

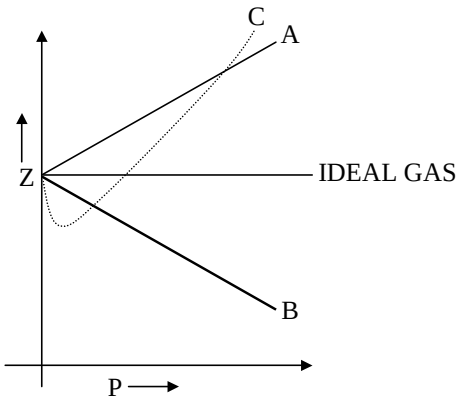
2005

Q.82 The ratio of the rate of diffusion of helium and methane under identical condition of pressure and temperature will be

(A) 4 (B) 2 (C) 1 (D) 0.05

2006

Q.83



where $Z = \frac{PV}{nRT}$,

a = Van der Waal's constant for pressure correction
b = Van der Waal's constant for volume correction

Pick the only incorrect statement

(A) for gas A, if a = 0, the compressibility factor is directly proportional to pressure
(B) for gas B, if b = 0, the compressibility factor is directly proportional to pressure.
(C) for gas C, $a \neq 0$, $b \neq 0$, it can be used to calculate a and b by giving lowest P value and its intercept with Z = 1
(D) slope for all three gases at high pressure is positive.

ANSWERS

OBJECTIVE

LEVEL I

1. B	**2.** D	**3.** C	**4.** A	**5.** B	**6.** C	**7.** B
8. B	**9.** D	**10.** A	**11.** A	**12.** A	**13.** C	

LEVEL II

1. CD	**2.** B	**3.** C	**4.** B	**5.** C	**6.** A	**7.** B
8. D	**9.** C	**10.** B				

LEVEL III

1. AC	**2.** AD	**3.** ACD	**4.** AB	**5.** BD	**6.** BC	**7.** ACD
8. BC	**9.** ABC	**10.** BCD	**11.** AC	**12.** ABC	**13.** BC	
14. ABC	**15.** C	**16.** BC				

LEVEL IV

1. (b) A-i, B-ii, C-iii

2. (a) A-i, B-ii, C-i, D-ii

3. (d) (A)-(iii), (B)-(i), (iv) , (C)-(i), (iv) (D)-(ii)

4. (a) (i) - CD; (ii) - CD; (iii)-D ; (iv) - B

5. (a) (i) - A, C ; (ii) - A, D ; (iii) - A,B ; (iv) - B, C

6. (d) (i) - A ; (ii) - D ; (iii) - A,C ; (iv) - B

7. (b) (i) - B, D ; (ii) - A, C ; (iii) - A, C ; (iv) - A, B, C, D

SUBJECTIVE

LEVEL I

1. 0.347 **2.** 99.93 atm **3.** P = 0.48 atm , T = 575 K **4.** 16 min

5. 349.80°C **6.** 3.2×10^{-8} cm

7. **(a)** 1.34×10^{-22} cm^3 **(b)** 80.71 cm^3 **(c)** 242.13 cm^3 **8.** **(a)** 7.76 mg **(b)** 4.60 mg

9. 4.88 g mol^{-1} **10.** 1.62×10^{-8} cm

LEVEL II

1. 824.4 gm **2.** 6.8×10^4 **3.** 478.3 kg/m^3 **4.** 6.240×10^3 m^3

5. 3.774 lit. **6.** **(a)** T 270 K **(b)** V = 2.239 lit. P = 0.99 atm **7.** 817 mm

8. 146.5 mm **9.** V = 232.06 ml **10.** P = 0.5714 atm **11.** m = 1.24 gm

12. P = 1129.6 mm

LEVEL III

1. 2.5 bar **2.** 0.8 bar **4.** 70g/mo **5.** $M_B = 4M_A$

6. 202.5 mL **7.** 8.314 × 104 Pa **8.** 1.8 bar **9.** $3g/dm^3$

10. 1247.7g **11.** 3/5 **12.** 50 K **13.** 4.2154×10^{23} electrons

14. 1.90956×10^6 year **15.** 56.025 bar **16.** 3811.1 kg

17. 5.05 L **18.** 40 g mol^{-1} **19.** 81.12 cm from HCl end

20. 417.4 g mol^{-1} **21.** 20 g mol^{-1} **22.** 7482.6 J mol^{-1} **23.** 0.8 bar

28. 1.347 bar

LEVEL IV

1. A **2.** B **3.** A **4.** 1.24 : 1 **5.** B **6.** 2.197 atm

7. 6.21×10^{-21} joules/molecule **8.** 2.7×10^{10} molecules **9.** 1 : 3

10. 900 **11.** = R **12.** B **13.** B **15.** D **16.** F

17. F **18.** 3.9×10^2 cm/sec **19.** A **20.** inversely, time

21. AB **22.** 0.25 **23.** 10 **24.** C **25.** B **27.** C

28. 1 : 16 **29.** B **30.** A **31.** 1682.5 K ; 2143.4 K **32.** D

33. 5.23 litre **34.** A **35.** 1033 **36.** 26.5 %; 42% ; 31.5 %

37. 0.221 atmp ; .00429 mol NO gas ; N_2O_4 is solid at 220 K **38.** False

39. D **40.** 494.2 m/s ; 405.2 m/s **41.** 8 : 1 **42.** 2.46 m^3 2.5 atmp

43. 4247.2 kg **44.** A **45.** 0.663 ; 0.337 **46.** C

47. 0.137 **48.** yes **49.** CH_4 = 20%, CO = 50%, He = 30% **50.** False

51. C **52.** B **53.** B **54.** B **55.** less **56.** $B = b - \frac{a}{RT}$

57. 0.492 atm ; 0.246 atm **58.** A **59.** C **60.** 123 gm/mole

61. 6.46 lit^2 atm mol^{-2} **62.** 4.53 g/litre **63.** 0.4

64. T = –173°C, V = 0.82 lit **65.** XeF_6 **66.** C **67.** B

68. D **69.** C **70.** False **71.** True **72.** 501.6 atm **73.** D

74. 1.2528 lit^2 atm mol^{-2} **75.** C

76. **(a)** **(i)** 18.09 gm/mol^{-1} **(ii)** 50.25 dm^3 mol^{-1} **(iii)** 1.22 **(iv)** repulsive
(b) 2.07×10^{-20} J

77. 434 m/sec **79.** C **80.** B **81.** RT **82.** B **83.** C