Miscellaneous Exercise Question Bank

1. A flask contains 12 g of a gas of relative molecular mass 120 at a pressure of 100 atm was evacuated by means of a pump until the pressure was 0.01 atm. Which of the following is best estimate of number of molecules left in the flask $(N_0 = 6 \times 10^{23} mol^{-1})$?

(A) 6×10^{19} **(B)** 6×10^{18} **(C)** 6×10^{17} **(D)** 6×10^{13}

2. Van dar Waal's equation for CH_4 at low pressure is :

(A) $PV = RT - Pb$ **(B)** $PV = RT - \frac{a}{V}$ **(C)** $PV = RT + \frac{a}{v}$ **(D)** $PV = RT + Pb$

3. Two gases of molecular mass M_A and M_B are taken in a container of volume 'V' at temperature. 'T'. If $M_A > M_B$ then average momentum change per collision of gases are such that [Assume ideal behaviour]

(A) $\Delta P_A > \Delta P_B$ **(B)** $\Delta P_B < \Delta P_A$ **(C)** $\Delta P_B = \Delta P_A$ **(D)** data insufficient

4. Solubility of gases in liquids

(A) Remains constant irrespectively of pressure
(B) Increases with increase of pressure
(C) Decrease with increase of pressure
(D) Increase with decrease of pressure

5. One mole of $N_2O_4(g)$ at 300 K is kept in a closed container under one atmosphere pressure. 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

***6.** Which of the given statement is(are) correct?

(A) Van der Waal constant a is a measure of attractive forces between atoms of a gas molecule
(B) Van der Waal constant b is also called co-volume or excluded volume
(C) Van der Waal constant 'a' is a measure of attractive forces between molecules
(D) 'a' is expressed in atm $L^2 mol^{-2}$

***7.** Which of the following relations is(are) not true?

(A) Most probable speed $v_{mp} = \sqrt{\frac{2RT}{M}}$ **(B)** $PV = RT$

(C) Compressibility factor $Z = \frac{RT}{PV}$ **(D)** Average kinetic energy of a gas $= \frac{1}{2}kT$

8. Two gases A & B (having molar masses $\frac{M_A}{M_B} = 2$) in two separate vessels at same P & T are allowed to diffuse through different orifices, circular orifice for A & square orifices for B. If radius of circular orifice is equal to length of square orifice, the rates of rats of diffusion $\frac{r_A}{r_B}$ is:

(A) $\frac{\pi}{\sqrt{2}}$ **(B)** 2π **(C)** $\sqrt{2}\,\pi$ **(D)** $\sqrt{\frac{2}{\pi}}$

***9.** Select correct statement/s regarding compressibility factor Z of a gas :

(A) Z for an ideal gas is independent of temperature and pressure

(B) Z for ideal gas is greater than one

(C) Z for non ideal gas is either < 1 or > 1 as well as dependent on temperature and pressure

(D) When $Z < 1$ then force of attraction dominates over force of repulsion

10. Which of the following statement is **INCORRECT**?

(A) Molar volume of every ideal gas at STP is 22.4 L

(B) Under critical states compressibility factor is 1

(C) All gases will have equal values of KE at a given temperature

(D) At absolute zero KE is zero

***11.** Which of the following are **CORRECT** statements ?

(A) Van der Waal's constant a is a measure of attractive force

(B) Van der Waal's constant b is also called co-volume or excluded volume

(C) b is expressed in $L\ mol^{-1}$

(D) b is one third of critical volume

***12.** When gas is expanded at constant temperature:

(A) Pressure decreases

(B) The kinetic energy of the molecules remain same

(C) Kinetic energy of the molecule decreases

(D) Number of molecules of gas increases

***13.** The **CORRECT** relation is:

(A) $T_C = \frac{8a}{27Rb}$ **(B)** $T_i = \frac{2a}{Rb}$ **(C)** $P_C = \frac{a}{27Rb^2}$ **(D)** $V_C = 3a$

Paragraph for Question No. 14-16

Under the same conditions of temperature and pressure the rate of diffusion of gas is inversely proportional to the square root of vapour density. Rate of diffusion is volume of gas diffused per unit time. Rate of diffusion $\propto \frac{1}{\sqrt{\text{vapour density}}}$ therefore $\frac{r_1}{r_2} = \sqrt{\frac{d_2}{d_1}} = \sqrt{\frac{2 \times d_2}{2 \times d_1}} = \sqrt{\frac{M_2}{M_1}}$.

Where M_1 and M_2 are molecular masses of gases. If the pressures are not same then : $\boxed{\frac{r_1}{r_2} = \frac{p_1}{p_2}\sqrt{\frac{M_2}{M_1}}}$

Choose the correct answer :

14. Hydrogen gas diffuses four times as rapidly as a mixture of C_2H_4 and CO_2 the molar ratio of C_2H_4 to CO_2 in the mixture is :

(A) 1 : 1 **(B)** 2 : 1 **(C)** 3 : 1 **(D)** 3 : 2

15. Two containers A and B have the same volume Container A contains 5 moles of O_2 gas Container B contains 3 moles of He and 2 moles of N_2. Both the containers have very small orifices of same area through which the gases leak out. The ratio of rate of effusion of O_2 with that of He and N_2 gas mixture will be:

(A) 0.48 **(B)** 0.65 **(C)** 0.65 **(D)** 0.92

16. The composition of the equilibrium mixture for equilibrium $Cl_2 \rightleftharpoons 2Cl$ at 1470 K may be determined by the rate of diffusion of a mixture through a pin hole. It was found that at 1470 K the degree of dissociation of Cl_2 is 0.14 then the ratio of rate of effusion of equilibrium mixture to that of krypton (atomic weight = 83.8) under similar conditions will be:

(A) 1.16 **(B)** 3.20 **(C)** 5.12 **(D)** 4.35

Paragraph for Question No. 17-19

According to the Dalton's law of partial pressure total pressure of a mixture of non reacting gases is equal to the sum of partial pressure of individual gases $P = P_A + P_B + P_C + ...$

Individual pressure of gas is called partial pressure. It is calculated as partial pressure of gas = (mole fraction) × total pressure.

17. Equal weight of methane and hydrogen are mixed in an empty container at $27°C$. The fraction of the total pressure exerted by hydrogen is :

(A) $\frac{1}{9}$ **(B)** $\frac{8}{9}$ **(C)** $\frac{2}{3}$ **(D)** $\frac{1}{3}$

18. Dalton's law of partial pressure does not hold good at $25°C$ for a mixture of :

(A) CO_2 and O_2 **(B)** He and H_2 **(C)** NH_3 and HCl **(D)** O_2 and N_2

19. In a gaseous mixture at $20°C$ the partial pressure of the components are H_2 : 150 torr, CH_4 : 300 torr, CO_2 : 200 torr, C_2H_4 : 100 torr. Volume percent of H_2 is:

(A) 26.67 **(B)** 73.33 **(C)** 80 **(D)** 20

Paragraph for Question No. 20-22

The gas which follows the Boyle's law and Charle's law is called ideal gas, On combining the Boyle's law and Charle's law we get ideal gas equation of state

$V \propto \frac{1}{P}$ (at constant T) – Boyle's law . . . . (i)

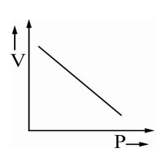
$V \propto T$ (at constant P) – Charle's law . . . . (ii)

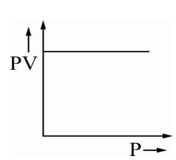
Combining equation (i) and (ii) we get

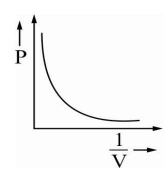
$$V \propto \frac{T}{P} \quad \Rightarrow \quad V = \frac{RT}{p}$$

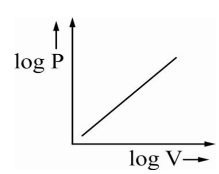
PV = nRT where R is universal gas constant for n moles of gas.

20. Which of the following graph represents the Boyle's law?

(A) 

(B) 

(C) 

(D) 

21. Which one of the following relationships when graphed does not give a straight line for helium gas?

I. K.E. and T at constant pressure and volume

II. P v/s V at constant temperature for a constant mass

III. V v/s 1/T at constant pressure for a constant mass

(A) II **(B)** II and III **(C)** III **(D)** I

22. A mixture of methane and ethene in the mole ratio x : y has a mean molecular weight = 20, what would be mean molecular weight if the same gases are mixed in the ratio y : x?

(A) 22 **(B)** 24 **(C)** 20.8 **(D)** 19

For Question No. 23-31

(A) Statement-I is True, Statement-II is True and Statement-II is a correct explanation for Statement-I.
(B) Statement-I is True, Statement-II is True and Statement-II is NOT a correct explanation for Statement-I.
(C) Statement-I is True, Statement-II is False.
(D) Statement-I is False, Statement-II is True.

23. **Statement : I** Critical temperature of inert gases is very low.

Statement : II Ionisation energy of inert gases are quite high.

24. **Statement : I** The pressure of a fixed amount of an ideal gas is proportional to its temperature at constant volume.

Statement : II Frequency of collisions and their impact both increase in proportion to the square root of temperature.

25. **Statement : I** All molecules of an ideal gas move with the same speed.

Statement : II There is no attraction between the molecules of an ideal gas.

26. **Statement : I** The value of the van der Waal's constant 'a' is larger for ammonia than for nitrogen.

Statement : II Hydrogen bonding is present in ammonia.

27. **Statement : I** Compressibility factor (Z) for non ideal gases is always greater than 1.

Statement : II Non ideal gases usually exert lower pressure than expected.

28. **Statement : I** SO_2 gas is easily liquefied while H_2 is not.

Statement : II SO_2 has low critical temperature while H_2 has high critical temperature.

29. **Statement : I** In van der Waal's equation $\left(P+\frac{a}{V^2}\right)(V-b)=RT$ pressure correction $\left(\frac{a}{V^2}\right)$ is due to force of attraction between molecules.

Statement : II Due to force of attraction volume of molecules cannot be neglected.

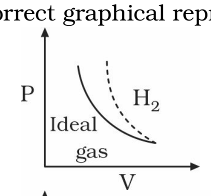
30. **Statement : I** Van der Waal's constant b is expressed in the unit of atm L^2mol^{-2}.

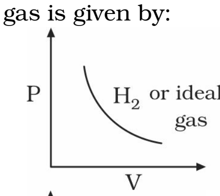
Statement : II 'a' is pressure correction due to force of attraction.

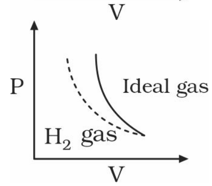
31. **Statement : I** When temperature of an ideal gas increases from $27°C$ to $127°C$ at constant P volume increases by 100 L.

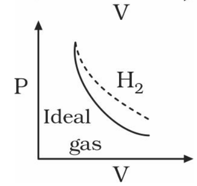
Statement : II $V \propto T$ at constant P.

32. The correct graphical representation for ideal gas & H_2 gas is given by:

(A) 

(B) 

(C) 

(D) 

33. Match the following :

	Column I		Column II
(A)	$H_2O > C_6H_6 > NH_3$	**(p)**	T_C
(B)	$NH_3 > C_6H_6 > H_2O$	**(q)**	Vapour pressure
(C)	$C_6H_6 > NH_3 > H_2O$	**(r)**	a (van der Waal constant)
(D)	Ethanol < HNO_3	**(s)**	b (van der Waal constant)
		(t)	Boiling point

34. Consider the Vander Waal Equation. Match the following :

	Column I		Column II
(A)	High pressure	**(p)**	$PV = RT + Pb$
(B)	Pressure is not too low	**(q)**	$PV = RT - \frac{a}{V}$
(C)	Force of attraction is negligible	**(r)**	$PV = RT$
(D)	Very high temperature and low pressure	**(s)**	$\left(P + \frac{a}{V^2}\right)(V - b) = RT$
		(t)	$z \simeq 1$

35. Two flasks A and B having volume 2 L and 4 L respectively. Flask A has H_2 gas at 2 atm and flask B has O_2 gas at 2 atm. If two flasks are connected by a pipe of negligible volume, what will be the final pressure?

36. 20 L air at $50°C$ having 90% relative humidity has been cooled to $25°C$ where it has 20% relative humidity. What is the new pressure of air if it was originally present at 4.57 atm?

Aq. tension at $50°C = 0.5\,atm$

Aq. tension at $25°C = 0.1\,atm$

37. A certain quantity of a gas occupied 100 ml when collected over water at $15^\circ C$ and $750\,mm$ pressure. It occupies 91.9 ml in dry state at NTP. Find the V.P. of water at $15^\circ C$.

(A) 20 mm **(B)** 13.2 mm **(C)** 18 mm **(D)** None of these

38. If the number of molecules of SO_2 (molecular weight = 64) effusing through an orifice of unit area of cross section in unit time at $0^\circ C$ and 1 atm pressure is n, the number of He molecules (atomic weight = 4) effusing under similar conditions at $273^\circ C$ and 0.25 atm is :

(A) $\frac{n}{\sqrt{2}}$ **(B)** $n\sqrt{2}$ **(C)** 2n **(D)** $\frac{n}{2}$

39. A gaseous mixture contains three gases A, B and C with a total number of moles of 10 and total pressure of 10 atm. The partial pressure of A and B are 3 atm and 1 atm respectively and if C has molecular weight of 2 g/mol. Then, the weight of C present in the mixture will be :

(A) 8 g **(B)** 12 g **(C)** 3 g **(D)** 6 g

40. Four particles have speed 2, 3, 4 and 5 cm/s respectively. Their rms speed is :

(A) 3.5 cm/s **(B)** (27/2) cm/s **(C)** $\sqrt{54}$ cm/s **(D)** $(\sqrt{54}/2)\text{cm/s}$

41. There are 6.02 × 10^{22} molecules each of N_2, O_2 and H_2 which are mixed together at 760 mm and 273 K. The mass of the mixture in grams is :

(A) 6.2 **(B)** 4.12 **(C)** 3.09 **(D)** 7

42. At $27^\circ C$, a gas is compressed to half of its volume. To what temperature it must now be heated so that gas occupies just its original volume ?

(A) $54^\circ C$ **(B)** $600^\circ C$ **(C)** $327^\circ C$ **(D)** 327 K

43. A gas in an open container is treated from $27^\circ C$ to $127^\circ C$. The fraction of original amount of gas remaining in the container will be :

(A) $\frac{3}{4}$ **(B)** $\frac{1}{4}$ **(C)** $\frac{1}{2}$ **(D)** $\frac{1}{8}$

44. A V dm^3 flask contains gas A and another flask of 2V dm^3 contains gas B at the same temperature. If density of gas A is $3.0\ g/dm^{-3}$ and of gas B is 1.5 g dm^{-3}, and molecular weight of $A = \frac{1}{2}$mol. wt of B then the ratio of pressure exerted by gases is :

(A) $\frac{P_A}{P_B} = 2$ **(B)** $\frac{P_A}{P_B} = 1$ **(C)** $\frac{P_A}{P_B} = 4$ **(D)** $\frac{P_A}{P_B} = 3$

45. 300 ml of a gas at $27^\circ C$ is cooled to $-3^\circ C$ at constant pressure, the final volume is :

(A) 540 ml **(B)** 135 ml **(C)** 270 ml **(D)** 350 ml

46. In the ideal gas equation, the gas constant R has the dimension of

(A) Mole – atm/K **(B)** Litre/mole

(C) Litre-atm/K/mole **(D)** erg/K

47. 3.7 gm of a gas at $25^\circ C$ occupied the same volume as 0.184 gm of hydrogen at $17^\circ C$ and at the same pressure. What is the molecular mass of the gas ?

(A) 82.66 **(B)** 41.33 **(C)** 20.67 **(D)** 10.33

48. 180 ml of hydrocarbon diffuses through a porous membrane in 15 minutes while 120 ml of SO_2 under identical conditions diffused in 20 minutes. What is the molecular mass of the hydrocarbon ?

(A) 8 **(B)** 16 **(C)** 24 **(D)** 32

49. At what temperature will hydrogen molecules have the same root mean square speed as nitrogen molecules at $27^\circ C$?

(A) $21.43^\circ C$ **(B)** 42.86 K **(C)** 21.43 K **(D)** $42.86^\circ C$

50. What is the total pressure exerted by the mixture of 7.0 g of N_2, 2g of hydrogen and 8.0 g of sulphur dioxide gases in a vessel of 6 L capacity that has been kept at $27^\circ C$.

(A) 2.5 bar **(B)** 4.5 bar **(C)** 10 atm **(D)** 5.7 bar

51. An open flask containing air is heated from 300 K to 500 K. What percentage of air will escape to the atmosphere, if the pressure is kept constant ?

(A) 80 **(B)** 40 **(C)** 60 **(D)** 20

52. A gas obeys the equation of state P(V – b) = RT (The parameter b is a constant). The slope for an isochore will be :

(A) negative **(B)** zero **(C)** R/(V – b) **(D)** R/P

53. Density of methane, at $250^\circ C$ and 6 atm pressure ; is [R = 0.0821 atm-L/mol/K] :

(A) 2.236 g/L **(B)** 8 g/L **(C)** 12 g/L **(D)** 16 g/L

54. The ratio among most probable velocity, mean velocity and root mean square velocity is given by :

(A) 1 : 2 : 3 **(B)** $1 : \sqrt{2} : \sqrt{3}$

(C) $\sqrt{2} : \sqrt{3} : \sqrt{8/\pi}$ **(D)** $\sqrt{2} : \sqrt{8/\pi} : \sqrt{3}$

55. The compressibility factor for nitrogen at 330 K and 800 atm is 1.90 and at 200 atm is 1.10. A certain mass of N_2 occupies a volume of 1 dm^3 at 330 K and 800 atm. Calculate volume occupied by same quantity of N_2 gas at 750 K and 200 atm.

(A) 1 L **(B)** 2 L **(C)** 3 L **(D)** 4 L

56. If the weight of 5.6 litres of a gas at N.T.P. is 11 gram. The gas may be :

(A) PH_3 **(B)** $COCl_2$

(C) NO **(D)** N_2O

57. The density of vapour of a substance (X) at 1 atm pressure and 500 K is 0.8 kg/m^3. The vapour effuse through a small hole at a rate of 4/5 times slower than oxygen under the same condition. What is the compressibility factor (Z) of the vapour ?

(A) 0.974 **(B)** 1.35 **(C)** 1.52 **(D)** 1.22

58. The volume of 2.8 g of CO at $27^\circ C$ and 0.821 atm pressure is (R = 0.0821 lit. atm $mol^{-1} K^{-1}$)

(A) 1.5 litre **(B)** 3 litre

(C) 30 litre **(D)** 0.3 litre

59. The van der Waals parameters for gases W, X, Y and Z are :

Gas	a (atm L^2 mol^{-2})	b (L mol^{-1})
W	4.0	0.027
X	8.0	0.030
Y	6.0	0.032
Z	12.0	0.027

Which one of these gases has the highest critical temperature?

(A) W **(B)** X
(C) Y **(D)** Z

60. 6 litre H_2O is placed in a closed room of volume 827 L at the temperature of 300 K. If vapour pressure of liquid water is 22.8 mm of Hg at 300 K and its density is 1 g/cm^3 :
[Given : R = 0.0821 atm. L mol^{-1} K^{-1}, Assuming volume of liquid water to be constant]

	Column-I		**Column-II**
(P)	Mass of H_2O in gaseous form (in g)	**(1)**	6
(Q)	Moles of H_2O in gaseous state	**(2)**	18
(R)	Approximate mass of water left in liquid state (in kg)	**(3)**	3
(S)	Total number of moles of all atoms in vapour form	**(4)**	1

Codes :

	P	Q	R	S		P	Q	R	S
(A)	1	2	4	3	**(B)**	4	3	2	1
(C)	2	3	1	4	**(D)**	1	2	3	4

61. A small bubble rises from the bottom of a lake, where the temperature and pressure are $8^{\circ}C$ and 6.0 atm, to the water's surface, where the temperature is $25^{\circ}C$ and pressure is 1.0 atm. Calculate the final volume of the bubble if its initial volume was 2 mL.

(A) 14 mL **(B)** 12.72 mL **(C)** 11.31 mL **(D)** 15 mL

62. At 273 K temp. and 9 atm pressure, the compressibility for a gas is 0.9. The volume of 1 millimoles of gas at this temperature and pressure is :

(A) 2.24 litre **(B)** 0.020 ml **(C)** 2.24 mL **(D)** 22.4 mL

63. The mass of molecule A is twice the mass of molecule B. The rms speed of A is twice the rms speed of B. If two samples of A and B contain same number of molecules and if the pressure of gas B is 2 atm then what will be the pressure of gas A (atm). If two samples are taken in separate containers of equal volume?

(A) 16 **(B)** 32 **(C)** 48 **(D)** 64

64. Consider a real gas placed in a container. If the intermolecular attraction are supposed to disappear suddenly which of the following would happen?

(A) The pressure decreases **(B)** The pressure increases
(C) the pressure remains unchanged **(D)** The gas collapses

***65.** Select incorrect statement:

(A) We can condense vapour in equilibrium with the liquid simply by applying pressure

(B) To liquefy a gas one must lower the temperature below T_C and also apply pressure

(C) At T_C, there is no distinction between liquid and vapour state hence density of the liquid is nearly equal to density of the vapour

(D) However great the pressure applied, a gas cannot be liquified below it's critical temp.

66. However great the pressure, a gas cannot be liquified above its:

(A) Boyle temperature **(B)** Inversion temperature

(C) Critical temperature **(D)** Room temperature

67. At low pressure van der Waal's equation for two moles of a real gas will show the relation :

(A) $\dfrac{PV}{\left[RT - \dfrac{a}{V}\right]} = 2$ **(B)** $\dfrac{PV}{RT - \dfrac{2a}{V}} = 2$ **(C)** $\dfrac{PV}{\left[RT - \dfrac{4a}{V}\right]} = 2$ **(D)** $\dfrac{PV}{RT - \dfrac{2a}{V}} = 4$

68. In vander Waal's equation of state for a non ideal gas the term that accounts for intermolecular forces is:

(A) nb **(B)** nRT **(C)** n^2a / V^2 **(D)** $(nRT)^{-1}$

69. The correct order of normal boiling points of O_2, N_2, NH_3 and CH_4, for whom the values of vander Waal's constant 'a' are 1.360, 1.390, 4.170 and 2.253 L^2.atm. mol^{-2} respectively, is:

(A) $O_2 < N_2 < NH_3 < CH_4$ **(B)** $O_2 < N_2 < CH_4 < NH_3$

(C) $NH_3 < CH_4 < N_2 < O_2$ **(D)** $NH_3 < CH_4 < O_2 < N_2$

70. The van der Waals parameters for gases W, X, Y and Z are :

Gas	**a(atm L^2 mol^{-2})**	**b(L mol^{-1})**
W	4.0	0.027
X	8.0	0.030
Y	6.0	0.032
Z	12.0	0.027

Which one of these gases has the highest critical temperature?

(A) W **(B)** X **(C)** Y **(D)** **Z**

71. Match the following :

	List-I (Conditions for real gas)		**List-II**
(P)	If force of attraction among gas particles are negligible	**(1)**	$PV_m = RT$
(Q)	At 1 atm and 273 K	**(2)**	$PV_m = RT - \dfrac{a}{V_m}$
(R)	If the volume of gas particles is negligible	**(3)**	$\left(P + \dfrac{a}{V_m^2}\right)(V_m - b) = RT$
(S)	At low pressure and high temperature	**(4)**	$PV_m = RT + Pb$

Codes:

	P	Q	R	S		P	Q	R	S
(A)	4	1	3	2	**(B)**	4	3	2	1
(C)	2	1	4	3	**(D)**	1	2	3	4

72. The temperature at which real gases obey the ideal gas laws over a wide range of pressure is called

(A) Critical temperature **(B)** Inversion temperature

(C) Boyle temperature **(D)** Reduced temperature

73. Match the following :

	Column-I		Column-II
(A)	H_2 gas at NTP	**(p)**	Molar volume = 22.4 L
(B)	O_2 gas having density more than $\frac{10}{7}$ g/L at NTP	**(q)**	Molar volume > 22.4 L
(C)	SO_2 gas at NTP having density more than $\frac{20}{7}$ g/L	**(r)**	More compressible with respect to ideal gas
(D)	He gas at NTP having density less than $\frac{1}{5.6}$ g/L	**(s)**	Less compressible with respect to ideal gas

74. Match the following :

	Column-I		Column-II
(A)	At low pressure	**(p)**	$Z = 1 + \frac{pb}{RT}$
(B)	At higher pressure	**(q)**	$Z = 1 - \frac{a}{V_m RT}$
(C)	At low density of gas	**(r)**	gas is more compressible
(D)	For H_2 and He at 0°C	**(s)**	gas is less compressible

75. Which of following statement(s) is true ?

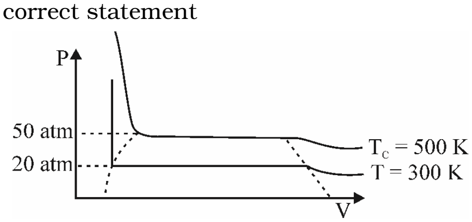
I. Slope of isotherm at critical point is maximum

II. Larger is the value of T_C easier is the liquification of gas

III. Vander waals equation of state is applicable below critical temperature at all pressure

(A) Only I **(B)** I & II **(C)** II & III **(D)** Only II

76. For a real gas the P-V curve was experimentally plotted and it had the following appearance with respect to liquefaction. Choose the correct statement



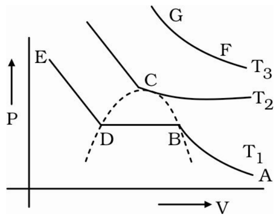
(A) At T = 500 K, P = 40 atm, the state will be liquid

(B) At T = 300 K, P = 50 atm, the state will be gas

(C) At T < 300 K, P > 20 atm, the state will be gas

(D) At 300 K < T < 500 K, P > 50 atm, the state will be liquid

77. Match the correct column from list-1 to list-2 on the basis of following Andrew's isotherm of real gas.



Column-I		Column-II	
(A)	Substance exists in both liquid and gas state	**(P)**	At AB part
(B)	Only liquid state exists	**(Q)**	At BD part
(C)	Substance exists in gas state only	**(R)**	At DE part
(D)	Real gas is called super critical fluid	**(S)**	At point C
		(T)	At GF curve

78. Gas molecules each of mass 10^{-26} kg are taken in a container of volume 1 dm^3. The root mean square speed of gas molecules is 1 km sec^{-1}. What is the temperature of gas molecules.
[Given : $N_A = 6 \times 10^{23}$; $R = 8\,J/mol.K$]

79. The vander waals constant 'b' of a gas is $4\pi \times 10^{-4}$ L/mol. The radius of gas atom can be expressed in scientific notation as $z \times 10^{-9}$ cm. Calculate the value of z. (Given $N_A = 6 \times 10^{23}$)

80. Calculate molecular diameter for a gas if its molar excluded volume is 3.2π ml. (in nanometer)

81. One mole of an ideal gas obey the relation : $P = \dfrac{P_0}{\left[1 + \left(\dfrac{V}{V_0}\right)^2\right]}$ where P_0 and V_0 are constants. At what temperature $V = V_0$?

(A) $\dfrac{P_0 V_0^2}{2R}$ **(B)** $\dfrac{P_0 V_0}{2R}$ **(C)** $\dfrac{P_0 V_0}{R}$ **(D)** $\dfrac{2P_0 V_0}{R}$

82. To an evacuated 504.2 mL steel container is added 25 g $CaCO_3$ and the temperature is raised to 1500 K causing complete decomposition of the salt. If the density of CaO formed is 3.3 g/cc, find the accurate pressure developed in the container using the Van der waals equation of state. The van der Waals constants for $CO_2(g)$ are : $a = 4\dfrac{L^2 - atm}{mol^2}, b = 0.04\dfrac{L}{mol}$. Report your answer as nearest whole number.

***83.** Which of the following statements are correct?

(A) It is not possible to compress a gas at a temperature below T_C

(B) At a temperature below T_C, the molecules are close enough for the attractive forces to act and condensation occurs

(C) No condensation takes place above T_C

(D) Due to higher kinetic energy of gas molecules above T_C, it is considered as super critical fluid

Comprehension # 1

One of the important approach to the study of real gases involves the analysis of a parameter Z called the compressibility factor $Z = \frac{PV_m}{RT}$ where P is pressure, V_m is molar volume, T is absolute temperature and R is the universal gas constant. Such a relation can also be expressed as $Z = \left(\frac{V_{m\ real}}{V_{m\ ideal}}\right)$ (where $V_{m\ ideal}$ and $V_{m\ real}$ are the molar volume for ideal and real gas respectively). Gas corresponding Z > 1 have repulsive tendencies among constituent particles due to their size factor, whereas those corresponding to Z < 1 have attractive forces among constituent particles. As the pressure is lowered or temperature is increased, the value of Z approaches 1 (the ideal behaviour)

84. Choose the conclusion which are appropriate for the observation stated.

Observation		**Conclusion**	
I.	$Z = 1$	**I.**	The gas need not be showing the ideal behavior
II.	$Z > 1$	**II.**	On applying pressure the gas will respond by increasing its volume
III.	$Z < 1$	**III.**	The gas may be liquefied
IV.	$Z \to 1$ for low P	**IV.**	The gas is approaching the ideal behaviour

(A) All conclusions are true **(B)** Conclusions I, II & IV are true
(C) Conclusions I, III & IV are true **(D)** Conclusions III & IV are true

85. For a real gas 'G', Z > 1 at STP then for 'G'. Which of the following is true:

(A) 1 mole of the gas occupies 22.4 L at NTP
(B) 1 mole of the gas occupies 22.4 L at pressure higher than that of STP (keeping temperature constant)
(C) 1 mole of the gas occupies 22.4 L at pressure lower than that at STP (keeping temperature constant)
(D) None of the above

86. At Boyle temperature :

(A) the effects of the repulsive and attractive intermolecular forces just offset each other
(B) the repulsive intermolecular forces are stronger than the attractive intermolecular forces
(C) the repulsive intermolecular forces are weaker than the attractive intermolecular forces
(D) $b - \frac{a}{RT} > 0$

87. A gas can be liquefied by pressure alone when its temperature

(A) Higher than its critical temperature **(B)** Lower than its critical temperature
(C) Either of these **(D)** None

88. A cylinder fitted with frictionless, weightless piston contains only water vapor at 15°C. The saturated vapor pressure of water is 14 mm of Hg at 15°C. The volume of cylinder is first halved by compressing the piston & then increased by 50%, keeping temperature constant. What is the final vapor pressure of water is cylinder?

(A) 8 mm **(B)** 14 mm **(C)** 9.33 mm **(D)** 15.2 mm

89. A vessel has N_2 gas and water vapours at a total pressure of 1 atm. The partial pressure of water vapours is 0.3 atm. The contents of this vessel are transferred to another vessel having one third of the capacity of original volume, completely at the same temperature the total pressure of this system in the new vessel is

(A) 3.0 atm **(B)** 1 atm **(C)** 3.33 atm **(D)** 2.4 atm

90. For two gases A and B with molecular weights M_A and M_B, it is observed that at a certain temperature T_1 the mean velocity of A is equal to the root mean square 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', $T > T'$

(B) A is lowered to a temperature T_2 , $T_2 < T$ while B is at T

(C) Both A and B are raised to a higher temperature

(D) Both A and B are placed at lower temperature

91. The circulation of blood in human body supplies O_2 and releases CO_2. the concentration of O_2 and CO_2 is variable but on an average, 100 ml blood contains 0.02 g of O_2 and 0.08 g of CO_2. The volume of O_2 and CO_2 at 1 atm and at body temperature 37°C, assuming 10 L blood in human body, is :

(A) 2 L, 4 L **(B)** 1.5 L, 4.5 L

(C) 1.59 L, 4.62 L **(D)** 3.82 L, 4.62 L

92. At 100°C and 1 atm, if the density of liquid water is 1.0 g/cc and that of water vapour is 0.0006 g/cc, then the volume occupied by water molecule in one litre of steam at that temperature is

(A) 6 cc **(B)** 60 cc **(C)** 0.6 cc **(D)** 0.06 cc

93. The K.E. of N molecule of O_2 is x Joules at −123°C. Another sample of O_2 at 27°C has a KE of 2x Joules. The latter sample contains.

(A) N molecules of O_2 **(B)** 2N molecules of O_2

(C) N/2 molecules of O_2 **(D)** N/4 molecule of O_2

94. If for two gases of molecular weights M_A and M_B at temperature T_A and T_B,$T_AM_B = T_BM_A$, then which property has the same magnitude for both the gases.

(A) Density **(B)** Pressure

(C) KE per mol **(D)** V_{rms}

95. Helium atom is two times heavier than a hydrogen molecule. At 298 K, the average kinetic energy of a Helium atom is

(A) two times that of 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

96. Dalton's law of partial pressure is not applicable to, at normal conditions

(A) H_2 and N_2 mixture **(B)** H_2 and Cl_2 mixture

(C) H_2 and CO_2 mixture **(D)** H_2 and O_2 mixture

97. The sealed containers of the same capacity and at the same temperature are filled with 44 g of H_2 in one and 44 g of CO_2 in the other. If the pressure of carbon dioxide in the second container is 1 atm. That of hydrogen in the first container would be :

(A) 1 atm **(B)** 10 atm **(C)** 22 atm **(D)** 44 atm

98. The maximum weight that a balloon can carry along is called payload.

Payload = weight of air displaced – (weight of balloon + weight of gas its contains). A balloon weighing 50 Kg is filled with 685.2 kg of helium at 1 atm pressure and 25°C. What will be its pay load if it displaced 5108 kg of air?

(A) 4372.8 kg **(B)** 4422.8 kg **(C)** 5793.2 kg **(D)** 5843.2 kg

99. How much should the pressure be increased in order to decrease the volume of a gas 5 % at a constant temperature?

(A) 5% **(B)** 5.26 % **(C)** 10 % **(D)** 4.26 %

100. Reducing the pressure from 1.0 to 0.5 atm would change the number of molecules in one mole of ammonia to :

(A) 75% of initial value **(B)** 50% of initial value

(C) 25% of initial value **(D)** none of these