CHEMISTRY

BOOKS - IIT-JEE PREVIOUS YEAR (CHEMISTRY)

STATES OF MATTER

Jee Main And Advanced

1. Two closed vessels of equal volume containing air at pressure P_1 and temperature

T_1 are connected to each other through a narrow tube. If the temperature in one of the vessels is now maintained at T_1 and that in the other at T_2, what will be the pressure in the vessels?

A. $2p_i\left(\frac{T_1}{T_1+T_2}\right)$

B. $2p_i\left(\frac{T_2}{T_1+T_2}\right)$

C. $2p_i\left(\frac{T_1T_2}{T_1+T_2}\right)$

D. $p_i\left(\frac{T_1T_2}{T_1+T_2}\right)$

Answer: B

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2. If Z is a compressibility factor, van der Waals' equation at low pressure can be written as

A. $Z = 1 + \frac{RT}{pb}$

B. $Z = 1 - \frac{a}{VRT}$

C. $Z = 1 - \frac{pb}{RT}$

D. $Z = 1 + \frac{pb}{RT}$

Answer: B

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3. For gaseous state, if most probable speed is denoted by C^* average speed by $\overline{C}$ and root square speed by C, then for a large number of molecules, the ratios of these speeds are

A. $C^* : \overline{C} : C = 1.225 : 1.128 : 1$

B. $C^* : \overline{C} = 1.128 : 1.225 : 1$

C. $C^* : \overline{C} : C = 1 : 1.128 : 1.225$

D. $C^* : \overline{C} : C = 1 : 1.225 : 1.128$

Answer: C

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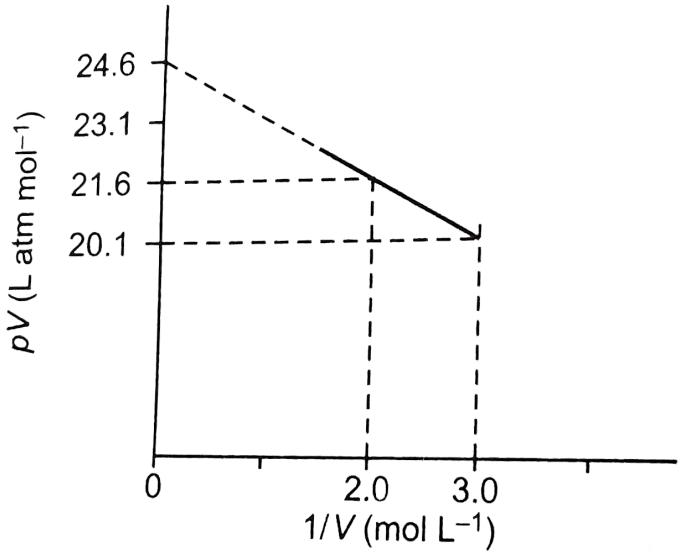
4. For one mole of a van der Waals' gas when $b = 0$ and $T = 300K$, the $pVvs1/V$ plot is shown below. The value of the vander Waals'

constant a(atm $Lmol^{-2}$)



A. 1

B. 4.5

C. 1.5

D. 3

Answer: C

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5. The term that corrects for the attractive forces present in a real gas in the van der Waal's equation is

A. nb

B. n^2a/V^2

C. $-\left(n^2a/V^2\right)$

D. $-nb$

Answer: B

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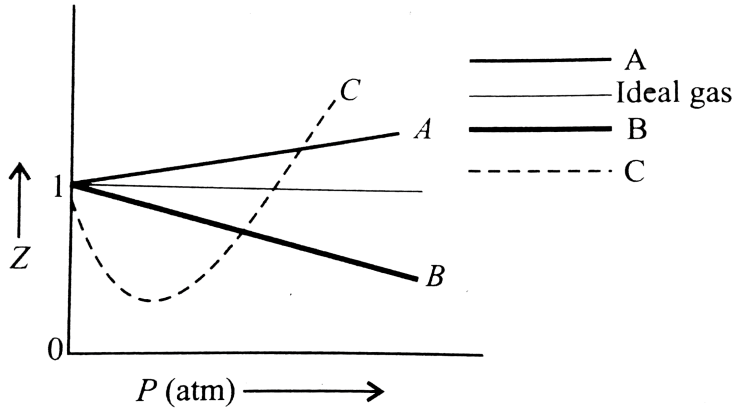
6. The given graph represents the variations of compressibility factor $Z = PV/nRT$ vs P for three real gases A, B, and C.



Identify the incorrect statements.

A. For the gas A, $a = 0$ and its dependence on p is linear at all pressure

B. For the gas B, $b = 0$ and its dependence on p is linear at all pressure

C. For the gas C which is typical real gas for which neither a nor $b = 0$. By knowing the minima and the point of intersection, with $Z = 1$, a and b can be calculated

D. At high pressure, the slope is positive for all real gases

Answer: B

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7. For a monatomic gas, kinetic energy $= E$. The relation with rms velocity is

A. $u = \left(\frac{2E}{m}\right)^{1/2}$

B. $u = \left(\frac{3E}{2m}\right)^{1/2}$

C. $u = \left(\frac{E}{2m}\right)^{1/2}$

D. $u = \left(\frac{E}{3m}\right)^{1/2}$

Answer: A

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8. Positive deviation from ideal behaviour takes place because of

A. molecular interaction between atom and

$pV/nRT > 1$

B. molecular interaction between atom and

$pV/nRT < 1$

C. finite size of atoms and $pV/nRT > 1$

D. finite size of atoms and $pV/nRT < 1$

Answer: A

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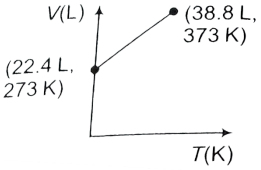
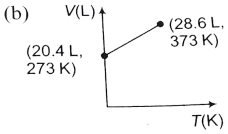
9. Which of the following volume-temperature $(V - I)$ plots represents the behaviour of

1mole of an ideal gas at the atmospheric pressure?

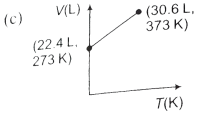
A.



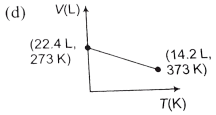
B.



C.



D.



Answer: C

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10. The root mean square velocity of an ideal gas to constant pressure varies with density (d) as

A. d^2

B. d

C. $\sqrt{d}$

D. $1/\sqrt{d}$

Answer: D

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11. The compressibility of a gas is less than unity at STP, therefore,

A. $V_m > 22.4L$

B. $V_m < 22.4L$

C. $V_m = 22.4L$

D. $V_m = 44.8L$

Answer: B

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12. The rms velocity of hydrogen is $\sqrt{7}$ times the rms velocity of nitrogen. If T is the temperature of the gas, then

A. $T(H_2) = T(N_2)$

B. $T(H_2) > T(N_2)$

C. $T(H_2) < T(N_2)$

D. $T(H_2) = \sqrt{7}T(N_2)$

Answer: C

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13. A gas will approach ideal behaviour at

A. low temperature and low pressure

B. low temperature and high pressure

C. high temperature and low pressure

D. high temperature and high pressure

Answer: C

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14. According to Graham's law, at a given temperature, the ratio of the rates of diffusion r_A / r_B of gases A and B is given by

A. $\left(\frac{p_A}{p_B}\right)\left(\frac{M_A}{M_B}\right)^{\frac{1}{2}}$

B. $\left(\frac{M_A}{M_B}\right)\left(\frac{p_A}{p_B}\right)^{\frac{1}{2}}$

C. $\left(\frac{p_A}{p_B}\right)\left(\frac{M_B}{M_A}\right)^{\frac{1}{2}}$

D. $\left(\frac{M_A}{M_B}\right)\left(\frac{p_B}{p_A}\right)^{\frac{1}{2}}$

Answer: C

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15. The compressibility factor for an ideal gas is

A. 1.5

B. 1.0

C. 2.0

D. ∞

Answer: B

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16. The ratio between the root mean square speed of H_2 at $50K$ and that of O_2 at $800K$ is

A. 4

B. 2

C. 1

D. $\frac{1}{4}$

Answer: C

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17. Equal weights of ethane and hydrogen are mixed in an empty container at $25^\circ C$. The fraction of the total pressure exerted by hydrogen is

A. $1:2$

B. $1:1$

C. $1:16$

D. $15:16$

Answer: D

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18. At constant volume, for a fixed number of moles of a gas, the pressure of the gas increases with the rise in temperature due to

A. increase in average molecular speed

B. increase rate of collisions amongst molecules

C. increase in molecular attraction

D. decrease in mean free path

Answer: A

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19. According to kinetic theory of gases, for a datomic molecule.

A. the pressure exerted by the gas is proportional to mean velociyt of the molecule

B. the pressure exerted by the gas is proportional to the root mean velocity of the molecule

C. the root mean square velocity of the molecule is inversely proportional to the temperature

D. the mean translational kinetic energy of the molecule is proportinal to the absolute temperature

Answer: D

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20. The rate of diffusion of methane at a given temperature is twice that of a gas X. The molecular weight of X is

A. 64

B. 32

C. 4

D. 8

Answer: A

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21. The density of neon will be highest at

A. STP

B. $0^\circ C$, 2 atm

C. $273^\circ C$, 1 atm

D. $273^\circ C$, 2atm

Answer: B

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22. The value of van der Waals constant a for the gases O_2, N_2, NH_3, and CH_4 are 1.360, 1.390, 4.170, and $2.253 L^2 atm mol^{-2}$, respectively. The gas which can most easily be liquefied is

A. O_2

B. N_2

C. NH_3

D. CH_4

Answer: C

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23. A bottle of dry ammonia and a bottle of dry hydrogen chloride 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 hydrogen chloride bottle

C. near the ammonia bottle

D. throughout the length of the tube

Answer: B

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24. In van der Waals equation of state for a non-ideal gas , the term that accounts for intermolecular forces is

A. $(V - b)$

B. RT

C. $\left(p + \frac{a}{V^2}\right)$

D. $(RT)^{-1}$

Answer: C

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25. The average velocity of an ideal gas molecule at $27^\circ C$ is $0.3ms^{-1}$. The average velocity at $927^\circ C$ will be

A. $0.6m/s$

B. $0.3m/s$

C. $0.9m/s$

D. $3.0m/s$

Answer: A

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26. The rate of diffusion of a gas is

A. direction proportional to its density

B. directly proportional to its molecular weight

C. directly proportinal to the square root of its molecular weight

D. inversely proportional to the square root of its molecular weight

Answer: D

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27. Equal weights of methane and hydrogen are mixed in an empty container at $25^{\circ}C$. The fraction of the total pressure exerted by hydrogen is

A. $\frac{1}{2}$

B. $\frac{1}{9}$

C. $\frac{1}{9}$

D. $\frac{16}{17}$

Answer: B

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28. 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

Answer: B

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29. A helium atom is two times heavier than a hydrogen molecule. At $298K$, the average kinetic 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

Answer: B

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30. Equal weights of methane and oxygen are mixed in an empty container at $25^{\circ}C$. The fraction of the total pressure exerted by oxygen is

A. $\frac{1}{3}$

B. $\frac{1}{2}$

C. $\frac{2}{3}$

D. $\frac{1}{3} \times 273298$

Answer: A

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

A. critical temperature

B. Boyle temperature

C. inversion temperature

D. reduced temperature

Answer: B

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32. The ratio of root mean square velocity of average velocity of a gas molecule at a particular temperture is

A. $1.085:1$

B. $1:1.086$

C. $2:1.086$

D. $1.086:2$

Answer: A

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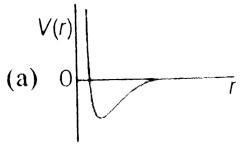
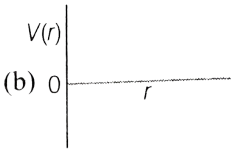
33. One mole of a monoatomic real gas satisfies the equation $p(V-b)=RT$ where b is a constant. The relationship of interatomic potential $V(r)$ and interatomic distance r for gas is given by

A. 

B.



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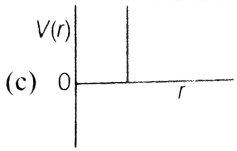

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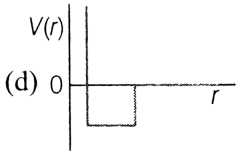

Answer: C

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34. According to kinetic theory of gases:

A. collisions are always elastic

B. heavier molecules transfer more momentum to the wall of the container

C. only a small number of molecules have very high velocity

D. between collisions, the molecules move in straight lines with constant velocities

Answer: A

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35. A gas described by van der Waals equation

.

A. behaves similar to an ideal gas in the limit of large molar volumes

B. behaves similar to an ideal gas in the limit of large pressures

C. is characterised by van der Waals' coefficients that are dependent on the idenitty of the gas but are independent of the temperature

D. has the pressure that is lower than the pressure exerted by the same gas behaving ideally

Answer: A::C

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36. If a gas expended at constant temperature

A. the pressure decreases

B. the kinetic energy of the molecules remains the same

C. the kinetic energy of the molecules decreases

D. the number of molecules of the gas increases

Answer: A::B

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37. Assertion: The pressure of a fixed amount of an ideal gas is proportional to its temperature.

Reason: The Frequency of collisions and their impact both increase in proportion of the square root of temperature.

A. Statement I is true: Statement II is true, Statement II is the correct explanation of Statement I.

B. Statement I is true, Statement II is true, Statement II is not the correct explanation of Statement I.

C. Statement I is true, Statement II is false.

D. Statement I is false, Statement II is true.

Answer: D

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38. Assertion: The value of van der Waals constant a is larger for ammonia than for nitrogen.

Reason: Hydrogen bonding is present in ammonia.

A. Statement I is true: Statement II is true, Statement II is the correct explanation of Statement I.

B. Statement I is true, Statement II is true, Statement II is not the correct

explanation of Statement I.

C. Statement I is true, Statement II is false.

D. Statement I is false, Statement II is true.

Answer: A

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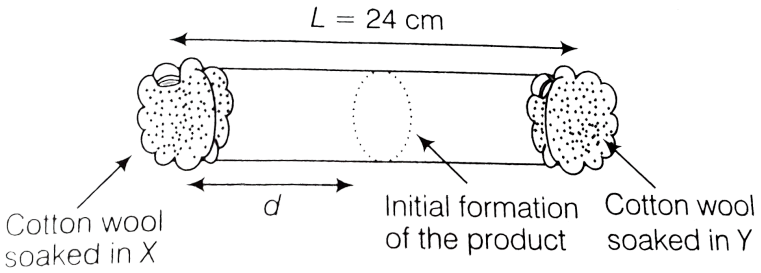
39. X and Y are two volatile liquids with molar weights of $10gmol^{-1}$ and $40gmol^{-1}$ respectively. Two cotton plugs, one soaked in X and the other soaked in Y, are

simultaneously placed at the ends of a tube of length $L = 24$ cm, as shown in the figure.

The tube is filled with an inert gas at 1 atm pressure and a temperature of $300K$. Vapours of X and Y react to form a product whichh is first observed at a distance $d$cm from the plug soaked in X.

Take X and Y to have equal molecular diameters and assume ideal behaviour for the inert gas and two vapours.



The experimental value of d is found to be smaller than the estimate obtained using Graham's law. This is due to

A. larger mena free path for X as a compared of that of Y

B. larger mean free path for Y as compared to that of X

C. increased collision frequency of Y with the inert gas as compared to that of X with the inert gas

D. increased collision frequency of X with the inert gas as compared to that of Y with the inert gas

Answer: D

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40. X and Y are two volatile liquids with molar weights of $10gmol^{-1}$ and $40gmol^{-1}$ respectively. Two cotton plugs, one soaked in X and the other soaked in Y, are

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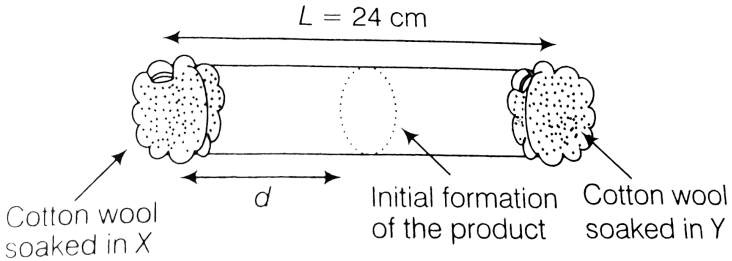

The value of d in cm (shown in figure), as estimated from Graham's law, is

A. 8

B. 12

C. 16

D. 20

Answer: C

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

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42. $8g$ each of oxygen and hydrogen at $27^\circ C$ will have the total kinetic energy in the ratio of .....

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43. The value of PV for $5.6L$ of an ideal gas is ..... RT at NTP.

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44. The rate of diffusion of a gas is.....proportional to both ..... And square root of molecular mass.

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45. $C_P - C_V$ for an ideal gas is..... .

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46. The total energy of $1mol$ of an ideal monatomic gas at $27^\circ C$ is..... .

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47. A mixture of ideal gases is cooled up to liquid helium temperature $(4.22K)$ to form an

ideal solution. Is this statement true or false?

Justify your answer in not more than two lines.

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48. In the van der 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.

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49. A gas in a closed container will exert much higher pressure due to gravity at the bottom than at the top.

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50. Kinetic energy of a molecule is zero at $0^{\circ} C$

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51. The diffusion coefficient of an ideal gas is proportional to its mean free path and mean speed. The absolute temperature of an ideal gas is increased 4 times and its pressure is increased 2 times.As a result, the diffusion coefficient of this gas increases x times. The value of x is.....

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52. A closed vessel with rigid walls contains 1 mole of $._{92}^{238}U$ and 1 mole of air at $298K$. Considering complete decay of $._{92}^{238}U$ to $._{82}^{206}Pb$the ratio of the final pressure to the initial pressure of the system at $298K$ is

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53. If the value of Avogadro numberis $6.023 \times 10^{23} mol^{-1}$ and the vaueof Boltzmann constant is $1.380 \times 10^{-23} JK^{-1}$, then the

number of significant digits in the calculated value of the universal gas constant is

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54. To an evacuated vessel with movable piston under external pressure of 1 atm 0.1 mole of He and 1.0 mole of an unknown compound vapour pressure 0.68 atm at $0^{\circ}C$ are introduced Considering the ideal gas behaviour the total volume (in litre) of the gases at $0^{\circ}C$ is close to .

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55. At $400K$ the root mean square (rms) speed of a gas x (mol. wt. =40) is equal to the most probable speed of gas y at $60K$ Find the molecular weight of gas y .

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56. The average velocity of gas molecules is $400ms^{-1}$. Calculate their rms velocity at the same temperature.

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

(a) Determine (i) molecular weight, (ii) molar volume (iii) compression factor(Z) of the vapour, and (iv) which forces among the gas molecules are dominating, the attractive or the repulsive?

(b) If the vapour behaves ideally at $1000K$, determine the average translational kinetic energy of a molecule.

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58. The compressibility factor for definite amount of van der Waals' gas at $0^{\circ}C$ and $100atm$ is found to be 0.5. Assuming the volume of gas molecules negligible, the van der Waals' constant a for gas is

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59. Calculate the pressure exerted by one mole of CO_2 gas at $273K$ van der Waals constant $a = 3.592 dm^6 atm mol^{-2}$. Assume that the volume occupied by CO_2 molecules is negligible.

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60. (a) One mole of nitrogen gas at $0.8 atm$ takes $38s$ to diffuse through a pinhole, whereas one mole of an unknown compound

of xenon with fluorine at $1.6atm$ takes $57s$ to diffuse through the same hole. Calculate the molecular formula to the compound.

(b) The pressure exerted by $12g$ of an ideal gas at temperature $t^{\circ}C$ in a vessel of volume $Vlitre$ is $1atm$. When the temperature is increased by $10^{\circ}C$ at the same volume, the pressure increases by $10\,\%$. Calculate the temperature t and volume V. (Molecular weight of the gas is 120.)

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61. Using van der Waals equation, calculate the constant a when $2mol$ of a gas confined in a $4L$ flasks exerts a pressure of $11.0atm$ at a temperature of $300K$. The value of b is $0.05Lmol^{-1}$.

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62. An evacuated glass vessel weighs $50.0g$ when empty, $148.0g$ when filled with a liquid of density $0.98gmL^{-1}$, and $50.5g$ when filled

with an ideal gas at $760mmHg$ at $300K$. Determine the molar mass of the gas.

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63. A mixture of ideal gases is cooled up to liquid helium temperature $(4.22K)$ to form an ideal solution. Is this statement true or false? Justify your answer in not more than two lines.

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64. The composition of the equilibrium mixture (Cl_2  $2Cl$) , which is attained at $1200^\circ C$, is determined by measuring the rate of effusion through a pin hole. It is observed that a $1.80 mm Hg$ pressure, the mixture effuses $1.16 \times$ as fact as krypton effuses under the same conditions. Calculate the fraction of chlorine molecules dissociated into atoms (atomic weight of Kr is 84).

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65. A mixture of ethane (C_2H_6) and ethene (C_2H_4) occupies $40L$ at $1.00atm$ and at $400K$. The mixture reacts completely with $130g$ of O_2 to produce CO_2 and H_2O. Assuming ideal gas behaviour, calculate the mole fractions of C_2H_4 and C_2H_6 in the mixture.

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66. An LPG cylinder weighs $14.8kg$ when empty. When full it weighs $29.0kg$ and the weight of the full cylinder reduces to $23.2kg$.

Find out the volume of the gas in cubic metres 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 $0^{\circ}C$.

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67. A 4 : 1 molar mixture of He and CH_4 is contained in vessel at 20 per pressure. Due to a hole in the vessel the gas mixture leakes out.

What is the compostion of mixture effusing out initially.

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68. A gas bulb of $1L$ capacity contains 2.0×10^{11} molecules of nitrogen exerting a pressure of $7.57 \times 10^{3} Nm^{-2}$. Calculate the root mean square (rms) speed and the temperature of the gas molecules. If the ratio of the most probable speed to the root mean

square is 0.82, calculate the most probable speed for these molecules at this temperature.

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69. At room temperature, the following reaction proceeds nearly to completion:

$2NO + O_2 \rightarrow 2NO_2 \rightarrow N_2O_4$

The dimer, N_2O_4, solidfies at $262K$. A $250mL$ flask and a $100mL$ flask are separated by a stopcock. At $300K$, the nitric oxide in the larger flask exerts a pressure of $1.053atm$ and

the smaller one contains oxygen at $0.789atm$. The gase are mixed by opening the stopcock and after the end of the reaction the flasks are cooled to $220K$. Neglecting the vapour pressure of the dimer, find out the pressure and composition of the gas remaining at $220K$. (Assume the gases to behave ideally)

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70. At $27^\circ C$, hydrogen is leaked through a tiny hole into a vessel for $20\ \min$. Another

unknown gas at the same temperature and pressure as that of hydrogen is leaked through the same hole for $20\ \mathrm{min}$. After the effusion of the gases, the mixture exerts a pressure of $6atm$. The hydrogen content of the mixture is $0.7mol$. If the volume of the container is $3L$, what is the molecular weight of the unknown gas?

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71. Calculate the volume occupied by $5.0g$ of acetylene gas at $50^{\circ}C$ and $740mm$ pressure.

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72. The average velocity of CO_2 at the temperature T_1 Kelvin and the most probable veloctiy at T_2 Kelvin is $9.0 \times 10^4 cms^{-1}$. Calculate the values of T_1 and T_2.

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73. A spherical ballon of $21cm$ diameter is to be filled with hydrogen at STP from a cylinder containing the gas at $20atm$ and $27^{\circ}C$. If the cylinder can hold $2.82L$ of water, calculate the number of balloons that can be filled up .

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74. Calculate the root mean square velocity of ozone kept in a closed vessel at $20^{\circ}C$ and $82cmHg$ pressure.

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75. Give reasons for the following in one or two sentences.

(a) A bottle of liquor ammonia should be cooled before open it the stopper.

(b) Equal volumes of gases contain equal number of moles.

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76. Oxygen is present in a $1L$ flask at a pressure of $7.6 \times 10^{-10} mmHg$. Calculate the number of oxygen molecules in the flask at $0^{\circ} C$.

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77. When $2g$ of a gas A is introduced into an evacuated flask kept at $25^{\circ} C$, the pressure is found to be $1atm$. If $3g$ of another gas B is then heated in the same flask, the total

pressure becomes $1.5atm$. Assuming ideal gas behaviour, calculate the ratio of the molecular weights M_A and M_B.

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78. At room temperature, ammonia gas at $1atm$ pressure and hydrogen chloride gas at $Patm$ pressure are allowed to effuse through identical pin holes from opposite ends of a glass tube of $1m$ length and of uniform cross-section. Ammonium chloride is first formed at

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

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79. Calculate the average kinetic energy (in joule) per molecule in $8.0g$ of methane at $27^\circ C$.

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80. The pressure in a bulb dropped from 2000 to $1500 mmHg$ in 47 min 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 min .

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81. A hydrocarbon contains $10.5g$ of carbon per gram of hydrogen. $1L$ of vapour of the hydrocarbon at $127^\circ C$ and 1 atm pressure weighs $2.8g$. Find the molecular formula of the hydrocarbon.

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82. If $3.7g$ of a gas at $25^\circ C$ occupies the same volume as $0.814g$ of hydrogen at $17^\circ C$ and at the same pressure, then what is the molecular weight of the gas?

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83. When $4.215g$ of a metallic carbonate was heated in a hard glass tube, the CO_2 evolved was found to measure $1336mL$ at $27^\circ C$ and $700mm$ pressure. What is the equivalent weight of the metal?

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84. Calculate the density of NH_3 at $30^\circ C$ and 5 atm pressure.

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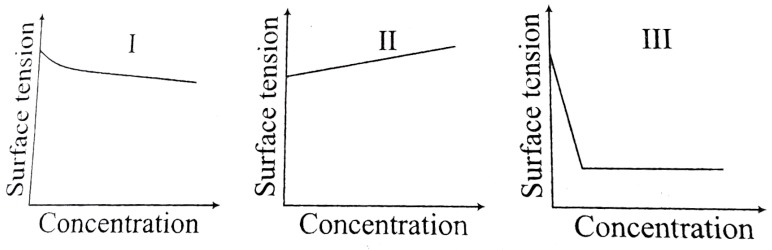
85. The equalitative sketches I, II and III given below show the variation of surface tension with molar concentration of three diferent aqueous solutions of KCl, CH_3OH and $CH_3(CH_2)_{11}OSO_3^-Na^+$ at room temperature.



The correct assignment of the sketches is

A.

$$KCl, CH_3OH, CH_3(CH_2)_{11}OSO_3^- Na^+$$

B.

$$CH_3(CH_2)_{11}OSO_3^- Na^+, CH_3OH, KCl$$

C. $KCl, CH_3(CH_2)OSO_3^- Na^+, CH_3OH$

D.

$$CH_3OH, KCl, CH_3(CH_2)_1)OSO_3^- Na^+$$

Answer: D

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86. At $100^{\circ}C$ and 1 atm, if the density of the liquid water is $1.0gcm^{-3}$ and that of water vapour is $0.0006gcm^{-3}$, then the volume occupied by water molecules in $1L$ steam at this temperature is

A. $6cm^3$

B. $60cm^3$

C. $0.6cm^3$

D. $0.06cm^3$

Answer: C

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87. The critical temperature of water is higher than that of O_2 because the H_2O molecule has

A. fewer electrons than O_2

B. two covalent bonds

C. V-shape

D. dipole moment

Answer: D

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88. A liquid is in equilibrium with its vapour at its boiling point. On average, the molecules in the two phases have equal

A. inter-molecular forces

B. potential energy

C. kinetic energy

D. total energy

Answer: C

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89. For gaseous reactions, the rate is expressed in terms of dP/dt instead of dc/dt or dn/dt (where c is the concentration and n the number of mol). What is the relation among these expresisons ?

A. $\frac{dC}{dt} = \frac{1}{V}\left(\frac{dn}{dt}\right) = \frac{1}{RT} = \left(\frac{dp}{dt}\right)$

B. $\frac{dC}{dt} = \left(\frac{dn}{dt}\right) = \left(\frac{dp}{dt}\right)$

C. $\frac{dC}{dt} = \frac{1}{V}\left(\frac{dn}{dt}\right) = \frac{V}{RT}\left(\frac{dp}{dt}\right)$

D. none of the above is correct

Answer: A

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90. Compressibility factor (Z) for a van der Waals real gas at critical point is

A. 1

B. $3/8$

C. $9/8$

D. $8/9$

Answer: B

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Objective Type

1. If helium and methane are allowed to difuse out of the container under the similar conditions of temperature and pressure, then

the ratio of rate of diffusion of helium to methane is

A. 2

B. 1

C. 0.5

D. 4

Answer: A

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2. If $2L$ of Cl_2 gas and $2L$ of ClF_3 gas react to form $6L$ of a pure gaseous compound at the same conditions of temperature and pressure, what is the molecular formula of the compound formed?

A. ClF

B. Cl_2F_2

C. Cl_3F_3

D. Cl_2F_5

Answer: A

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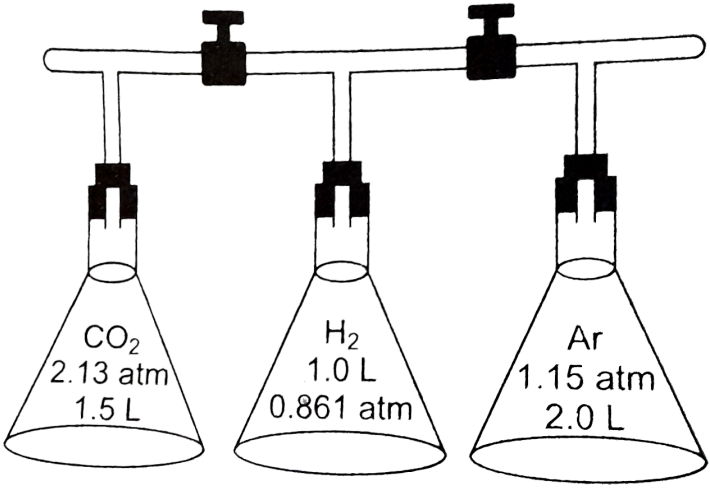
3. In the following figure, when the two stopcocks are opened, the total pressure inside the flask will be



A. 1.41 atm

B. 2.41 atm

C. 3.41 atm

D. 1.12 atm

Answer: A

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4. Which of the following is/are correct?

(I) If liquid "kryptonite"(from Superman's home planet), wilth a denisty twice that of mercury is used in a barometer on earth, one standard

atmosphere of pressure would sport a column of mercury 380 mm in height.

II. At constant volume and number of moles of gas, the pressure exhibited by an ideal gas is directly proportional to its absolute temperature.

III At standard temperature and pressure (STP), the volume of a mixture of gases containing 0.400 mole H_2, 0.600 mole N_2 and 1.00 mole of O_2 is $44.8L$ and the mole fraction of N_2 is 0.300.

A. Only II

B. Only III

C. II and III

D. All are correct

Answer: D

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5. Which of the following is(are) true for real gases? (C represents some constant value of R represents molar gas constant).

A. $\lim_{p \to 0} (pV) = C$ at constant temperature

B. $\lim_{V \to 0} (pV) = C$s at constant temperature

C. $\lim_{P \to 0} \left(\frac{pV}{RT} \right) = 1$

D. $\lim_{V \to 0} \left(\frac{pV}{RT} \right) = R$

Answer: A::C

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6. Which of the following statements is (are) correct?

A. The ratio of the average 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 average speed at ay temperature for different gases diminishes as larger and yet larger molar masses are considered

Answer: A::C::D

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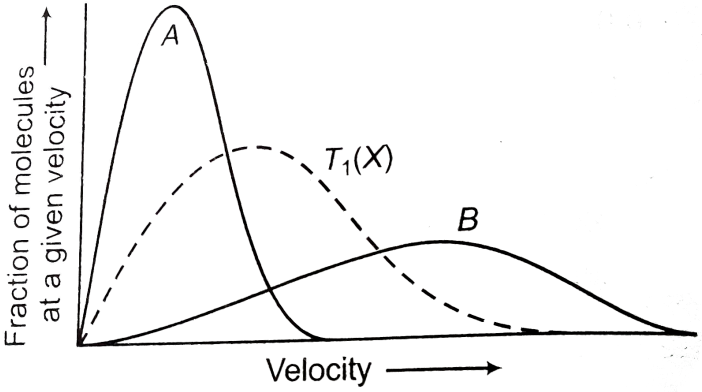
7. Knowing that average kinetic energy of an ideal gas (X) is directly proportinal to absolute temperature, if $T_1 = 273K$, which statements describe the other curves?



A. Curve A is for heavier gas but at same temperature

B. Curve B is for the same gas but at `373K

C. Curve A is for the same gas but at `373K

D. Curve B is for lighter gas but a same temperature

Answer: A::B::D

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8. For a non-ideal gas, the compressibility factor (Z) is defined as:

$Z = \frac{pV_m}{RT}, V_m =$ Molar volume

Compressibility of an unknown gas at $600K$

and 1.0 atm was found to be 1.2 Also this gas was found to effuse 1.58 times slower than the pure methane gas under identical condition. Answer the following three questions based on the above mentioned information and the information provided in an individual question.

Molar volume of the gas in the given experimental condition is

A. $40.8L$

B. $39.2L$

C. $58.8L$

D. $27.2L$

Answer: C

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9. For a non-ideal gas, the compressibility factor (Z) is defined as:

$Z = \frac{pV_m}{RT}, V_m =$ Molar volume

Compressibility of an unknown gas at $600K$ and 1.0 atm was found to be 1.2 Also this gas was found to effuse 1.58 times slower than the

pure methane gas under identical condition.

Answer the following three questions based on the above mentioned information and the information provided in an individual question.

The value of the Virial coefficient $'B'$ in the Virial equation is,

(Ignore the higher terms from equation during calculation)

Virial equation : $Z = 1 + \frac{B}{V_m} + \frac{C}{V_m^2} + \frac{D}{V_m^3} + ..., V_m$ is the molar volume

A. $8.16 L mol^{-1}$

B. $7.84 L mol^{-1}$

C. $11.76 mol^{-1}$

D. $5.44 L mol^{-1}$

Answer: C

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Match The Column

1. Match the gases under specified conditions listed in Column I with their properties /laws in Column II

	Column I		Column II
A.	Hydrogen gas ($p = 200$ atm, $T = 273$ K)	p.	compressibility factor $\neq 1$
B.	Hydrogen gas ($p \sim 0, T = 273$ K)	q.	attractive forces are dominant
C.	CO_2 ($p = 1$ atm, $T = 273$ K)	r.	$pV = nRT$
D.	Real gas with very large molar volume	s.	$p(V - nb) = nRT$

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Comprehension Type

1. For a non-ideal gas, the compressibility factor (Z) is defined as:

$Z = \frac{pV_m}{RT}$, $V_m =$ Molar volume

Compressibility of an unknown gas at $600K$ and 1.0 atm was found to be 1.2 Also this gas was found to effuse 1.58 times slower than the pure methane gas under identical condition. Answer the following three questions based on the above mentioned information and the information provided in an individual question.

Density of the gas in the above mentioned experimental condition is

A. $0.98gL^{-1}$

B. $0.68gL^{-1}$

C. $1.02gL^{-1}$

D. $1.47gL^{-1}$

Answer: B

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Ar Type

1. Assertion Ammonia has higher critical temperature than CO_2

Reason Ammonia forms intermolecular hydrogen bonds while CO_2 does not.

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2. Assertion At same temperature if equal number of molecules is considered, O_2 has greater fractions of molecules moving with most probable than CO_2

Reason Most probable speed is inversely related to square root of molar mass.

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Match The Columns

1. Match the statements of ColumnI with values of Column II

	Column I		Column II
A.	Average kinetic energy	p.	Depends on molar mass
B.	Most probable speed	q.	Depends on van der Waals constants *a* and *b*
C.	Rate of effusion	r.	Depends on temperature
D.	Boyle temperature	s.	Is characteristic of a gas.

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Integer Type

1. A gaseous mixture of methane and heptane is 8.25 ratio (by weight) respectively is allowed to effuse through a pin ole in the flask. How

many methane molecules would come out by the time when the first molecule of heptane is out?

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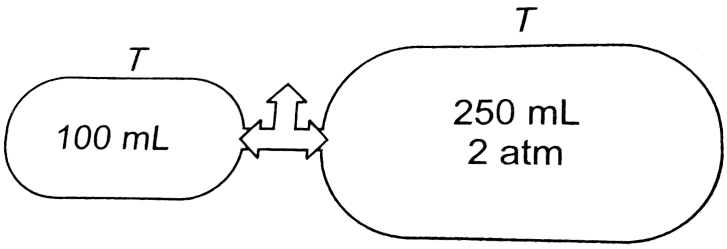
2. Consider and ideal gas at same temperature, separated initially as shown below in the diagram



When the valve is opened, the equilibrium

pressure is found to be $20/7$ atmosphere. What was the initial pessure in the smaller flask?

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