CHEMISTRY

BOOKS - PRADEEP CHEMISTRY (HINGLISH)

STATES OF MATTER : GASES AND LIQUIDES

Sample Problem

1. (a) Name the type of intermolecular forces existing in the molecules of BCl_3, NCl_3 and $NHCl_2$.

(b) Which of these is most likely to exist in the condensed state and which one is least likely?

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2. Arrange the following molecules in increasing order of intermolecular forces : C_2H_6, CH_3NH_2, CH_3F and CH_2F_2

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3. A manometer is connected to a gas containing bulb The open arm reads $43.7cm$ where as the arm connected to the bulb reads $15.6cm$ If the barometric pressure is 743mm mercury What is the pressure of gas in bar ? .

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4. A Vessel of $120mL$ capacity contains a certain mass of gas at $20^\circ C$ and $75mm$ pressure. The gas was transferred to a

vessel whose volume is $180mL$. Calculate the pressure of the gas at $20^\circ C$

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5. $103mL$ of carbon dioxide was collected at $27^\circ C$ and $763mm$ pressure. What will be its volume if the pressure is changed to $721mm$ at the same temperature?

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6. A balloon is filled with hydrogen at room temperature. It will burst if pressure exceeds 0.2 bar. If at 1 bar pressure the gas occupies 2.27 L volume,upto what volume can the balloon be expanded ?

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7. $20mL$ of hydrogen measured at $15^\circ C$ is heated to $35^\circ C$. What is the new volume at the same pressure?

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8. At what temperature in centigrade will the volume of a gas at $0^\circ C$ double itself, pressure remaining constant?

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9. A 10.0 litre container is filled with a gas to a pressure of 2.00 atm at $0^\circ C$. At what temperature will the pressure inside the container be 2.50 atm ?

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10. An open vessel contains200 mg of air at $17^{\circ}C$. What weight percent of air would be expelled if the vessel is heated to $117^{\circ}C$?

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11. On a ship selling in pacific ocean where temperature is $23^{\circ}C$ a ballon is filled with 2L air what will be the volume of the ballon when the ship reaches indian ocean where temperature is $26.1^{\circ}C$?

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12. An iron cylinder contains helium at a pressure of 250 kPa at 300K. The cylinder can withstand a pressure of $1 \times 10^6 Pa$. The room in which cylinder is placed catches fire. Predict whether the cylinder will blow up before it melts or melts or not. (M.P. of the cylinder=1800 K)

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13. 38.00 mL of moist nitrogen gas were collected at $27^\circ C$ and 746.5 mm pressure. Calculate the volume of the gas at $0^\circ C$ and 760 mm pressure, (Aq. Tension at $27^\circ C$ is 26.5 mm).

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14. 250 mL of nitrogen maintained at 720 mm pressure and 380 mL of oxygen maintained at 650 mm pressure of the misture ?

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15. A given mass of a gas occuples 919.0 mL in dry state at STP. The same main when collected over water at $15^{\circ}C$ and 750 mm pressure occupies one litre volume. Calculate the vapour pressure of water at $15^{\circ}C$.

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16. A neon-dioxygen mixture contains 70.6 g dioxygen and 167.5 g neon.If the pressure of the mixture ? (Atomic mass of Ne=20 u)

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17. Calculate the total pressure in a 10.0 L cylinder which contains 0.4 g helium, 1.6 g oxygen and 1.4 g nitrogen at 27°C.

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18. Which will diffuse faster, ammonia or CO_2? What are their relative rates diffusion ?

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19. Equal volumes of two gases A and B diffuse through a porous pot in 20 and seconds respectvely.If the molar mass of A is 80, calculate the molar mass of B.

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20. $20dm^3$ of of SO_2 diffuse through a porous partion in 60 s. What volume of will diffuse under similar conditions in 30s ?

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21. 127 mL of a certain gas diffuse in the same time as 10 mL of chlorine under the same conditions. Calculate the molarcular mass of the gas.

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

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23. A 4:1 molar mixture of He and CH_4 is 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 ?

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24. At $100^\circ C$, liquid water and water vapour (stea) are present together in equilibrium. Comment on the average kinetic energy of water molecules in the liquid water and steam.

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25. Calculate the pressure exerted by 110 g of carbon dioxide in a vessel of 2 L capacity at $37^\circ C$. Given that the van der Waals constants are a=3.59 $L^2 atm mol^{-2}$ and b=0.0427 L

mol^{-1}. Compare the value with the calculated value if the gas were considered as ideal.

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26. Calculate the temperature of 2 moles of sulphur dioxide gas contained in a 5 L vessel at 10 bar pressure. Given that for SO_2 gas, van der Waals constants are : a=6.7 bar L^2mol^{-2} and b=0.0564 L mol^{-1}.

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27. One mole of SO_2 gas occupies a volume of 350 mL at $27^\circ C$ and 50 atm pressure. Calculate the compressibility

factor of the gas. Comment on the type of deviation shown by the gas form ideal behaviour.

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28. The van der Waals constant 'b' for oxygen is 0.0318 L mol^{-1}. Calculate the diameter of the oxygen molecule.

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29. Using van der Waals equation calculate the constant 'a' when two molesof a gas confined in a four litre flask exerts a pressure of 11.0 atmosphere at a temperature of 300 K. The value of 'b' is $0.05 litmol^{-1}$

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30. Gases possess characteristic critical temperature which depends upon the magnitude of intermolecular forces between the gas particles. Critical temperatures of ammonia and carbon dioxide are 405.5 K and 304.10 K respectively. Which of these gases will liquify first when you start cooling from 500 K to their critical temperature ?

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Problem

1. At $25^{\circ} C$ and 760 mm of Hg pressure, a gas occupies 600 mL volume. What will be its pressure at a height where temperature is $10^{\circ} C$ and volume of the gas is 640 mL ?

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2. 35 mL of oxygen were collected at $6^{\circ}C$ and 758 mm pressure. Calculate its volume at NTP.

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3. At $27^{\circ}C$ and one atmospheric pressure, a gas has volume V. What will be its volume at $177^{\circ}C$ and a pressure of 1.5 atmosphere ?

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4. A sealed tube which can withstand a pressure of 3 atmosphere is filled with air at $27^{\circ} C$ and 760 mm pressure. Find the temperature above which it will burst.

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5. Calculate the number of moles of hydrogen contained in 18 litres of the gas at $27^{\circ} C$ and 70 cm pressure. Given that R=0.0821 litre atm K^{-1}. Further, if the mass of hydrogen taken as above is found to be 1.350 g, calculate the molecular mass of hydrogen.

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6. 10 g of O_2 were introduced into an evacuated vessel of 5 litre capacity maintained at $27^\circ C$. Calculate the pressure of the gas in atmosphere in the container.

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7. 8 g of methane is placed in 5 litre container at $27^\circ C$. Find Boyle constant.

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8. Calculate the temperature at which 28 g of N_2 will occupy a volume of 10.0 litres 2.46 atmosphere.

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9. An evacuated glass vessel weights 50.0 g when empty, 148.0 g when filled with a liquid of density 0.98 g mol^{-1} and 50.5 g when filled with an ideal gas at 760 mm Hg at 300 K. Determine the molecular weight of the gas.

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10. What is density of SO_2 gas at $27^\circ C$ and 2 atmospheric pressure ? (At. Wts. S=32, O=16, R=0.0821 L atm $K^{-1}mol^{-1}$)

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11. The density of a gas is found to be 1.56 g/litre at 745 mm pressure and $65^\circ C$. Calculate the molecular mass of the gas.

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12. The density of oxygen at S.T.P. is 16 g dm^{-3}. To what temperature it should be heated at a constant pressure that the density becomes 8 g dm^{-3} ?

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13. At $27^{\circ}C$ a gas contains 10 molecules travelling with a speed of 4 ms^{-1}, 20 molecules travelling with a speed of 5 m s^{-1} and 40 molecules travelling with a speed of 8 m s^{-1}. Calculate the average speed, root mean square speed and most probable speed of the gas at $27^{\circ}C$.

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14. (a) Calculate the total and average kinetic energy of 32 g methane molecules at $27^\circ C \left(R = 8.314 JK^{-1} mol^{-1}\right)$

(b) Also calculate the root mean square speed, average speed and most probable speed of methane molecules at $27^\circ C$.

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15. The average kinetic energy of a gas molecule at $0^\circ C$ is $5.621 \times 10^{-21} J$. Calculate Boltzmann costant. Also calculate the number of molecules present in one mole of the gas.

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16. At what temperature, average velocity of oxygen molecule is equal to the rms velocity at $27^\circ C$?

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17. Calculate the root mean square speed (rms) of ozone kept in a closed vessel at $50^\circ C$ and pressure of 82 cm of Hg.

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18. The average velocity ofgas molecules is $400 m / \sec$. Calculate its rms velocity at the same temperature .

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Problems For Practice

1. A certain mass of a gas occupies 39 mL at 760 mm pressure. What volume would it occupy if the pressure is raised to 780 mm provided that temperature remains constant ?

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2. 200 mL of a gas are found to have a pressure of 750 mm. What will be its volume if the pressure is doubled at the same temperature ?

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3. A balloon filled with an ideal is taken from the surface of the sea deep to a depth of 100 m. What will be its volume in terms of its original volume ?

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4. A bulb 'X' of unknown volume containing a gas at one atmospheric pressure is connected to an evacuated bulb of 0.5 litre capacity through a stop -cock. On opening the stop-cock, the pressure in the whole system after some time was found to have a constant value of 570 mm at the same temperature. What is the volume of the bulb X ?

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5. A gas occupies a volume of $2.5L$ at $9 \times 10^5 Nm^{-2}$. Calculate the additional pressure required to decrease the volume of the gas to $1.5L$, Keeping temperature constant.

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6. 300 mL of oxygen gas at -$10^\circ C$ are heated to $10^\circ C$. What is the new volume if pressure remains constant ?

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7. $25dm^3$ of ammonia at 283 K are heated until its volume is $30dm^3$. To what temperature must it have been raised to accomplish the change ?

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8. What will be volume of hydrogen when 3 litres of it are cooled from $15^{\circ}C \rightarrow -73^{\circ}C$ at constant pressure ?

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9. What volume of air will be expelled from a vessel containing $400cm^3$ at $7^{\circ}C$ when it is heated to $27^{\circ}C$ at the same pressure?

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10. A steel tank containing air at 15 pressure at $15^{\circ}C$ is provided with a safety valve that will yield at a pressure of

30 atm. To what minimum temperature must the air be heated to blow the safety valve ?

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11. It is desired to increase of the volume of a gas by 20% without changing the pressure. To what temperature, the gas must be heated if the initial temperature of the gas is 27° ?

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12. A gas cylinder containing cooking gas can withsand a pressure of 14.9 atmosphere. The pressure gauge of the cylinder indicates 12 atmosphere at $27^\circ C$. Due to a sudden

fire in the building the temperature starts rising. At what temperature will the cylinder explode ?

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13. 500 mL of nitrogen at $27^\circ C$ are cooled to $5^\circ C$ at the same pressure. Calculate the new volume.

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14. 400 mL of oxygen at $27^\circ C$ were cooled to $15^\circ C$ without the change in pressure. Calculate the contraction in volume.

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15. A volume of hydrogen measures one cubic decimetre at $20^{\circ}C$ and at a pressure of half an atmosphere. What will be its volume at $10^{\circ}C$ and at 700 mm pressure ?

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16. 300 L of ammonia gas at $20^{\circ}C$ and 20 atm pressure is allowed to expand in a space of 600 L capacity and to a pressure of 1 atm. Calculate the drop in temperature.

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17. A 1 L flask cantaing vapours of methyl alcohol (molar mass 32) at a pressure was 10^{-3} mm. How many molecules of

mehtyl alcohol are left in the flask ?

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18. 28.32 litres of chlorine were liberated at normal conditions of temperature. Calculate the volume of the gas at $12^{\circ}C$ and 780 mm pressure.

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19. Temperature at the foot of a mountian is $30^{\circ}C$ and pressure is 760 mm, whereas at the top of the mountain these are $0^{\circ}C$ and 710 mm. Compare the densities of the air at the foot and top of the mountain.

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20. Calculate the number of moles of hydrogen gas present in $500cm^3$ of the gas taken at 300K and 760 mm pressure. If this sample of hydrogen is found to have a mass equal to 4.09×10^{-2}g, calculate the molar mass of hydrogen.

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21. 2.802 g of N_2 gas is kept in one litre flask at $0^\circ C$. Calculate the pressure exerted by the gas.

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22. Calculate the molar volume of gas at STP -

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23. A 500 mL sample of a gas weighs 0.326 g at $100^{\circ}C$ and 0.500 atm. What is the molecular mass of the gas

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24. A large flask fitted with a stop-cock is evacuated and weighted, its mass is found to be 134.567 g. It is then filled to a pressure of 735 mm at $31^{\circ}C$ with a gas of unknown molecular mass and then reweighed, its mass is 137.456g. The flask is then filled with water and weighed again, its mass is now 1067.9g. Assuming that the gas is ideal, calculate the molar mass of the gas.

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25. The density of a gas is found to be 3.43 g/litre at 300K and 1.00 atm pressure. Calculate the molar mass of the gas.

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26. If the density of a gas at the sea level at $0^{\circ}C$ is $1.29kgm^{-3}$, what is its molar mass? (Assume that pressure is equal to 1bar.)

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27. 200 mL of hydrogen and 250 mL of nitrogen each measured at $15^{\circ}C$ and 760 mm pressure are but together in

a 500 mL flask. What will be the final pressure of the mixture at $15^{\circ} C$?

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28. 400 mL of N_2 gas at 700 mm and 300 mL of H_2 gas at 800 mm were introduced into a vessel of 2 litres at the same temperature. Calculate the final pressure of the gas mixture.

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29. Two vessels of capactie 1.5 L and 2.0 L containing hydrogen at 750 mm pressure and oxygen at 100 mm pressure, respectivity are connected to each other through a

valve. What will be the final pressure of the gaseous mixture assuming that the temperature remains constant?

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30. A 2-L flask contains 1.6 g of methane and 0.5 g of hydrogen at $27^{\circ}C$. Calculate the partial pressure of each gas in the mixture and hence calculate the total pressure.

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31. A gasesous mixture contains 56 gN_2,44 g CO_2 and 16 g CH_4. The total pressure of the mixture is 720 mm Hg. What is the partial pressure of CH_4 ?

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32. Calculate the molar mass of an unknown gas which diffuses 1.117 times faster than oxygen oxygen gas through same aperture under the same conditions of temperature and pressure.

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33. If 25 mL of CO_2 diffuses out of a vessel in 75 seconds, what volume of SO_2 would diffuse out in the same time under the same conditions ?

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34. Uranium isotopes have been separated by taking advantage of the different rates of diffusion of the two formsof uranium hexafluoride, one containing U-238 isotope and the other containing U-235. What are the relative rates of diffusion of these two molecules under ideal conditions ?

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35. 50 mL of hydrogen takes 10 minutes to diffuse out of a vessel. How long will 40 mL of oxygen take to diffuse out under similar conditions ?

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36. The reaction between gaseous NH_3 and HBr produces a white solide NH_4Br. Suppose a small quantity of gaseous NH_3 and gaseous HBr are introduced simultaneously into opposite ends of an open tube which is one metre long. Calculate the distance of white solid formed from the end which was used to introduce NH_3

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37. The volumes of ozone and chlorine diffusing in the same time are $35mL$ and $29mL$, respectively. If the molecular weight of chlorine is 71, calculate the molecular weight of ozone.

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38. Calculate the root mean square, average and most probable speeds of oxygen molecules at $27^{\circ} C$.

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39. Calculate (i) and root mean square speed (ii) average speed and (iii) most probable speed of CO_2 molecules at 700 K.

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40. A sample of a gas contains 15 molecules with a speed of 3m s^{-1}, 25 molecules with a speed of 5 m s^{-1} and 30

molecules with a speed of 8 m s^{-1}. Calculate root mean square speed of these molecules.

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41. Calculate the temperature at which the average speed of oxygen equals that of hydrogen at 20 K.

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42. Calculate the temperature at which the root mean square speed, average speed and most probable speed of oxygen gas are all equal to $1500 ms^{-1}$

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43. Calculate the pressure exerted by 10.2g of $NH_3 3dm^3$ vessel at $25^\circ C$ (a) using ideal gas equation (b) using van der Waals equation . The van der Waals constants are : $a = 4.17 dm^6 \ \text{atm} mol^{-2}, b = 0.0371 dm^3 mol^{-1}$

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44. 180 g of steam is contained in a vessel of 25 L capacity under a pressure of 50 atm. Calculate the temperature of the steam. Given that for water vapour, $a = 5.46 \ \text{bar} L^2 mol^{-2}$ and $b = 0.031 L mol^{-1}$.

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Curiosity Question

1. When we apply brakes of our car, which property of the brake fluid is applicable

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2. CO_2 is heavler than n_2 and O_2 gases present in the atmosphere, yet it does not form the lower layer of the atmosphere. Why ?

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3. Why is mercury used in thermometers ?

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4. What is the difficulty faced by the mountaineers with respect to the air present around them ? How is this difficulty solved ?

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5. Boyle's law states that at constant temperature, If pressure is Increased on a gas, volume decreases and vice-versa. But when we fill air in a balloon, volume as well as pressure Increase. Why ?

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6. Why hot air Is filled in the balloons used for meteorogical observations ?

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7. Why dry air is heavier than moist air?

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8. A type tube with a pin hole is first filled with oxygen to a pressure of 30 Ib/sq inch and allowed to leak out. Then it is filled with N_2 gas to the same pressure and allowed to leak out again. In which case, the time taken will be more and why ?

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9. Give reasons for the following :

(i) The size of weather balloon becomes larger and larger as it ascends into higher altitudes.

(ii) Tyres of automobiles are inflated to lesser pressure in summer than in winter.

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10. The molecular speeds of gaseous molecules are analogous to those to rifle bullets , why do then odour of the gaseous molecular not detected so fast ?

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11. Why at one time gases like helium, hydrogen and nitrogen were called permanent gases bt not now ?

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12. What is the difference between gas and vapour ?

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13. Why an Insect can walk on ordinary water but sinks in soapy water ?

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14. Steel is denser than water but a blade made from it floats on the surface of water. Why ?

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15. If equal amounts of ether, acetone and bezene are placed in identical petri dishes, in which order, they will evaporate off and why ?

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16. Why are falling liquid drops spherical?

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17. When we increase the temperature of a liquid, it starts flowing faster. Why ?

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Advanced Problems For Competitions

1. 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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2. A perfectly elastic spherical balloon of 0.02 m diameter was filled with hydrogen at sea level. What will be its diameter when it has risen to an altitude where the pressure is 0.65 atm ? (Assume no change in temjperature and atmospheric at sea level).

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3. Nitric oxide reacts with oxygen as

$$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$$

Initially NO and O_2 are separated as shown in the Fig. When the value is opened, the reaction quickly goes to completion. Identify the gases that remain at the end of the reaction and calculate their partial pressures. Assume temperature

remains constant at $25^{\circ} C$.

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4. A gas is heated in such a way that its pressure and volume both become double. Now by decreasing temperature, some of air molecules were introduced into the container to maintain the increased volume and pressure. Assuming $1/4^{th}$ of the initial number of moles has been given for this purpose. By what fraction of temperature has been raised finally of initial absolute temperature.

A. $\frac{16}{5}$ times

B.

C.

D.

Answer:

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5. 5 g of unknown gas has pressure P at a temperature T K in a vessel. On increasing the temperature by $50^{\circ} C$, 1 g of the gas was given out to maintain the pressure P. The original temperature was :

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6. The root mean square speed of molecules of nitrogen gas is v at a certain temperature. When the temperature is

doubled, the molecules dissociate into individual atoms. Calculate the factor by which root mean square speed of the individual atoms increases.

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7. 1 litre of N_2 and $7/8$ litre of O_2 at the same temperature and pressure were mixed together. What is the relation between the masses of the two gases in the mixture ?

A. $M_{N_2} = 3M_{O_2}$

B.

C.

D.

Answer:

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8. A 10-L vessel filled with O_2 at 300 K is connected to an open limb manometer containing glycerine. The level in the open limb was found to be higher than the other limb by 50 cm. Calculate the number of moles of the gas in the vessel (Given $d_{\text{glycerine}} = 2.72 gmL^{-1}$, $d_{Hg} = 13.6 gmL^{-1}$)

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9. 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 square velocity of B.

thus the mean velocity of A can be made equal to the mean velocity of B, if:

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10. 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 the average, $100mL$ blood contains $0.02g$ of O_2 and $0.08g$ of CO_2. Calculate the volume of O_2 and CO_2 at 1 atmosphere and body temperature of $37^\circ C$ assuming $10L$ of blood in human body.

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

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12. A mixture of NO_2 and N_2O_4 has a vapour density of 38.3 at 300 K. What is the number of moles of NO_2 in 10 moles of the mixture ?

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13. A balloon which can be inflated upto 1 L is partially inflated with air and has a volume of 275 mL and contains 0.0120 mole of air. A piece of dry ice (solid CO_2) weighing 1.0 g is introduced into the vaporised, assuming that temperature and pressure remain constant. calculate the volume of balloon after addition of dry ice.

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14. Assuming oxygen molecule to be spherical in shape, calculate the volume of a single molecule of oxygen if its radius is 150 pm. Also calculate the percentage of empty space in one mole of the gas at STP.

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15. The critical constant of a gas are as follows :

$P_c = 45.6 \ \text{atm}, V_c = 0.0987 \ \text{L} \ mol^{-1}$ and $T_c = 190.6 \ \text{K}$.

Calculate the van der Waals constants of the gas. Also calculate the radius of the gas molecule assuming it to be spherical.

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16. Assuming that dry air contains 79% N_2 and 21% O_2 by volume, calculate the density of dry air at if it has a relative humidity of 40%. The vapour pressure of water at $25^\circ C$ is 23.76 mm.

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17. 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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18. A glass bulb contains $2.24LofH_2$ and $1.12L$ of D_2 at STP. It is connected a fully evacuated bulb by a stop-cock with a small opening. The stop-cock is opened for sometime and then closed. The first bulb now contains $0.10g$ of H_2. The percentage of H_2 in the mixture is

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19. 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) the molecular weight, (ii) the molar volume (iii) the 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 $100K$, determine the average translational kinetic energy of a molecule.

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Test Your Grip

1. When two ice cubes are pressed over each other, they unite to form one cube. Which of the following forces is responsible to hold them together ?

A. Dipole forces

B. van der Waals forces

C. Covalent forces

D. Hydrogen bond forces

Answer: D

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2. The slope of the plot between pV and p at constant temperature is

A. zero

B. 1

C. $1/2$

D. $1/\sqrt{2}$

Answer: A::B::C::D

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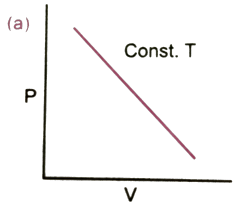
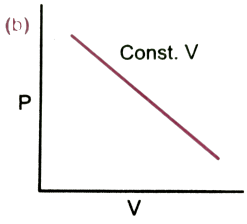
3. Which of the following diagram correctly describes the behaviour of a fixed mass of an ideal gas ? (T is measured in K)

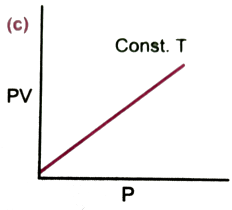
A.



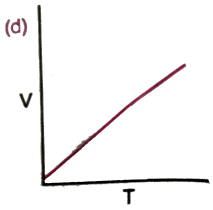
B.



C.



D.



Answer: A::B::C::D

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4. If 300 ml of a gas weigh 0.368 g at STP, what is its molecular weight ?

A. 30.16

B. 2.55

C. 27.5

D. 37.5

Answer: A::B::C::D

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5. The density of neon will be highest at

A. STP

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

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

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

Answer: B::D

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6. Gas equation $PV = nRT$ is obeyed by

A. only isothermal process

B. only adiabatic process

C. Both (a) and (b)

D. None of these.

Answer: C

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7. Molar volume of CO_2 is maximum at

A. N.T.P.

B. $0^\circ C$ and $2.0atm$

C. $127^\circ C$ and 1atm

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

Answer: C

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8. The density of a gas a is twice that of gas B. Molecular mass of A is half of the molecular of B. The ratio of the partial pressures of A and B is :

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

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

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

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

Answer: A::B::C::D

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9. 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. $(P_A / P_B)(M_A / M_B)^{1/2}$

B. $(M_A / M_B)(P_A / P_B)^{1/2}$

C. $(P_A / P_B)(M_B / M_A)^{1/2}$

D. $(M_A / M_B)(P_B / P_A)^{1/2}$

Answer: A

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10. Two gases A and B having the same volume diffuse through a porous partition in 20 and 10 seconds respectively. The molar mass of A is $49u$. Molar mass of B will be

A. 25.00 u

B. 50.00 u

C. 12.25 u

D. 6.50 u

Answer: A::B::C

Watch Video Solution

11. Which of the following pairs will effuse at the same rate through a porous plug .

A. CO, NO_2

B. NO, C_2H_6

C. NO_2, CO_2

D. NH_3, PH_3

Answer: A::B::C

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Watch Video Solution

12. The root mean square velocity of one mole of a monoatomic gas having molar mass M is $U_{r.m.s.}$. The relation between the average kinetic energy (E) of the gas and U_{rms} is

A. $U_{r.m.s.} = \sqrt{\frac{3E}{2M}}$

B. $U_{r.m.s.} = \sqrt{\frac{2E}{3M}}$

C. $U_{r.m.s.} = \sqrt{\frac{2E}{M}}$

D. $U_{r.m.s.} = \sqrt{\frac{E}{3M}}$

Answer: C

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13. The ratio of most probable velocity to that of average velocity is

A. $(\pi / 2)$

B. $2 / \pi$

C. $\sqrt{\pi} / 2$

D. $2 / \sqrt{\pi}$

Answer: B::C

Watch Video Solution

14. Which one of the following statement is not true about the effect of an increase in temperature on the distribution of molecular speed of gas ? .

A. The most probable speed increases.

B. The fraction of the molecules with the most probable speed increases.

C. The distribution becomes broader.

D. The area under the distribution curve remains the same as under the lower temperature.

Answer: B

Watch Video Solution

15. The rms velocity molecules of a gas of density $4kgm^{-3}$ and pressure $1.2 \times 10^5 Nm^{-2}$ is

A. $900ms^{-1}$

B. $120ms^{-1}$

C. $600ms^{-1}$

D. $300ms^{-1}$

Answer: A::C::D

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16. Dominance of strong repulsive forces among the molecules of the gas ($Z =$ compressibility factor)

A. depends on Z and indicated by Z=1

B. depends on Z and indicated by $Z > 1$

C. depends on Z and indicated by $Z > 1$

D. is independent of Z

Answer: B

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17. The ratio of van der Waals constants a and b, $\left(\frac{a}{b}\right)$ has the dimension of :

A. atm L^{-1}

B. L atm L^{-1}

C. atm mol L^{-1}

D. atm L mol^{-2}

Answer: A::B

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

A. nb

B. $\frac{an^2}{V^2}$

C. $-\frac{an^2}{V^2}$

D. $-nb$

Answer: B

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19. The van der waals constant 'a' for different gases are given below :

Gas	$a\left(\text{atm lit}^{-2}\text{mol}^{-2}\right)$
O_2	1.36
N_2	1.39
CH_4	2.25
NH_3	4.17

The gas that can be most easily liquefied is

A. O_2

B. N_2

C. CH_4

D. NH_3

Answer: A::B::C::D

Watch Video Solution

20. If helium is allowed to expand in vacuum, it liberates heat because

A. Helium is an inert gas

B. Helium is an ideal gas

C. The critical temperature of helium is very low

D. Helium is one of the lightest gases

Answer: A::C

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21. The vapour pressure of water at 300 K in a closed container is 0.4 atm . If the volume of the container is doubled , its vapour pressure at 300 K will be ____.

A. 0.8 atm

B. 0.2 atm

C. 0.4 atm

D. 0.6 atm

Answer: A::C::D

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22. Surface tension vanishes at

A. Boiling point

B. Critical point

C. Condensation point

D. Triple point

Answer: A::B::C::D

Watch Video Solution

23. If the four tubes of a car are filled to the same pressure with N_2, O_2, H_2, and helium separately , then which one will be filled first ?

A. N_2

B. O_2

C. H_2

D. Ne

Answer: A::B::C::D

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24. The incorrect statement among the following is

A. The boiling point of a liquid at one bar is called standard boiling oint of the liquid

B. The vapour pressure of a liquid is constant temperature

C. The SI unit of coefficient of viscosity of a pascal second

D. The boiling point of liquid is same external pressures.

Answer: D

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25. The temperature below which a gas does not obey ideal gas laws is

A. Critical temperature

B. Inversion temperature

C. Boyle temperature

D. Reduced temperature

Answer: C

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26. Van der Waals real gas acts an ideal gas at which conditions?

A. High temperature, low pressure

B. Low temperature, high pressure

C. High temperature, high pressure

D. Low temperature, low pressure

Answer: A

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27. The temperature at which the volume of a gas is zero

A. $0^{\circ}C$

B. 0 K

C. 0 F

D. None of these.

Answer: B

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Fill In The Blank

1. The point on the pressure temperature phase diagram where all the phases co-exist is called

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2. The only motion exhibited by the constituent particles of a solid is .....

Watch Video Solution

3. Dipole-dipole, dipole-induced dipole and dispersion forces are collectively called as .....

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4. Assertion: The plot of volume (V) versus pressure (P) at constant temperature is a hyperbola in the first quadrant.

Reason: $V \propto 1/P$ at constant temperature.

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5. The linear plot of volume in litres versus temperature in degrees centigrade on extrapolation cuts the temperature axis at .....

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6. Molar volume of a gas at $0^{\circ}C$ and 1 bar pressure is .....

Watch Video Solution

7. The value of gas constant in the units of bar $dm^3K^{-1}mol^{-1}$ is .....

Watch Video Solution

8. Aqueous tension of water depends only on .....and not on .....

Watch Video Solution

9. The rate of diffusion of a gas is directly proportional to the square root of ..... .

Watch Video Solution

10. The ratio of average speed to root mean square speed of the gas molecules is .....whereas that between most probable speed to root mean square speed is .....

Watch Video Solution

11. With increase in temperature, the fraction of molecules possessing most probable speed .....

Watch Video Solution

12. Average kinetic energy per molecule of a gas is related to its temperature as $\overline{K}E$=..... .

Watch Video Solution

13. The temperature at which a real gas behaves like an ideal gas over an appreciable pressure range is called ..... .

Watch Video Solution

14. The ratio of molar volume to ideal molar volume is called .....

Watch Video Solution

Watch Video Solution

15. The SI units of the van der Waals constant 'a' are ..... .

Watch Video Solution

16. Gases show deviation from ideal bahaviour when the pressure is.....and temperature is .....

Watch Video Solution

17. The temperature above which the gas cannot be liquefied by any amount of pressure is called.....

Watch Video Solution

18. The SI units of the coefficient of viscosity is .....

.

Watch Video Solution

19. The effect of increase of temperature on surface tension and viscosity is that ..... .

Watch Video Solution

20. The effect of increase of the enthalpy of vaporisation of a liquid (in joules mol^{-1}) to its boiling point (in degrees K) is equal to ..... . This rule is known as .....

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Conceptual Questions Differentiating Three States Of Matter And Intermolecular Forces

1. Arrange solid, liquid and gas in order of energy, giving reasons.

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2. Which type of intermolecular forces exist among the following molecules ?

(i) H_2S molecules

(ii) H_2O molecules

(iii) CL_2 and CCl_4 molecules

(iv) SiH_4 molecules

(v) Helium atomms

(vi) He atoms HCl molecules

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Conceptual Questions Measurement Of Mass Volume Temperature And Pressure Gas Laws And Ideal Gas Equation

1. How do you convert

(a) pressure in atmospheres into SI units ? (b) temperature in $^\circ C$ to temperature in $^\circ F$?

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2. What type of graph would you get when PV is plotted against P at constant temperature ?

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3. At a certain altitude, the density of air is 1/10th of the density of the earth's atmosphere and temperature is $-10^{\circ}C$. What is the pressure at that altitude ? Assume that air behaves like an ideal gas, has uniform composition and is at S.T.P. at the earth's surface.

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4. How is the pressure of a gas in a mixture related to the total pressure of the mixture?

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5. Compare the rates of diffusion of $^{'235}UF_6$ and $^{'238}UF_6$

Watch Video Solution

Conceptual Questions Kinetic Theory Of Gases Kinetic Energy And Molecule Speeds

1. Respresent the relative values of most probable speed, average speed and root mean square speed on Maxwell's distribution curve for speeds.

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2. What is the relationship between average kinetic energy and the temperature of a gas ?

Watch Video Solution

3. What is the ratio of average kinetic energy of oxygen molecules to that of ozone molecules at $27^{\circ} C$?

Watch Video Solution

4. What is the difference between total kinetic energy and translational kinetic energy ? For what type of molecules,

the two are equal ?

Watch Video Solution

Conceptual Questions Behaviour Of Real Gases And Van Der Waals Equation

1. The van der Waals constants for two gases are as follows :

Gas	$a\left(atmL^2mol^{-2}\right)$	$b\left(LMol^{-1}\right)$
X	1.39	0.0391
Y	3.59	0.0427

Which of them is more easily liquefiable and which has greater molecular size ?

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2. Out of N_2 and NH_3, which one will have greater value for van der Waals constant 'a' and which one will have greater value for der Waals constant 'b' ?

Watch Video Solution

Conceptual Questions Liquefaction Of Gases And Critical Tempetature

1. Critical temperature of NH_3 and SO_2 are 405.0 and 430.3 K respectively. Which one will have higher value of van der Waals constant 'a' and why ?

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Conceptual Questions Liquid State And Properties Of Liquids Vapour Pressure Surface Tension And Viscosity

1. A liquid is transferred from a smaller vessel to a bigger vessel at the same temperature. What will be the effect on the vapour pressure?

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2. What is the value of normal boiling point and standard boiling point of water?

Watch Video Solution

3. What happens when a liquid a heated to the critical temperature of its vapour?

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Questions And Exercises With Answers

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

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2. a vessel of 120 mL capacity contains a certain amount of gas at 1.2 bar pressure and $35^\circ C$. The gas is transferred to

another vessel of volume 180 mL at $35^{\circ} C$. What would be its pressure?

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3. Using the equation of state $pV = nRT$, show that at a given temperature the density of gas is proportional to gas pressure p.

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4. At $0^{\circ} C$ the density of a gaseous oxide at 2 bar is same as that of nitrogen at 5 bar What is the molecular mass of the oxide ? .

Watch Video Solution

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

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6. What will be the pressure exerted by a mixture of $3.2g$ of methane and $4.4g$ of carbon dixide contained in a $9dm^3$ flask at $27^\circ C$? .

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7. What will be the pressure of the gas mixture when $0.5L$ of H_2 at 0.8 bar $2.0L$ of oxygen at 0.7 bar are introduced in a $1L$ vessel at $27^\circ C$?

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8. Density of a gas is found to be $5.46/dm^3$ at $27^\circ C$ at 2 bar pressure What will be its density at STP ? .

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9. 34.05 mL of phosphorus vapour weights 0.0625 g at $546^\circ C$ and 1 bar pressure. What is the molar mass of phosphorus?

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10. A student forgot to add the reaction mixture to the round bottomed open flask at $27^{\circ}C$ and put it on the flame After a lapse of time he realized his mistake using a pyrometer he found the temperature of the flask was $477^{\circ}C$ What fraction of air would have been expelled out ? .

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11. Calculate the temperature of 4.0 moles of a gas occupying 5 dm^3 at 3.32 bar (R=0.083 bar $dm^3K^{-1}mol^{-1}$)

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

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13. Calculate the total pressure in a mixture og $8g$ of oxygen and $4g$ hydrogen confined in a vessel of $1dm^3$ at $27^\circ C$. $\left(R = 0.083 \text{bar} dm^3 K^{-1} mol^{-1}\right)$

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14. Pay load is defined as the difference between the mass of displaced air and the mass of the ballon Calculate the pay-

load when a balloon of radius $10m$ mass $100kg$ is filled with helium at 1.66 bar at $27^\circ C$ (Density of air $= 1.2kgm^{-3}$ and $R = 0.083$ nar $dm^{-3}K^{-1}mo1^{-1}$) .

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15. Calculate the volume occupied by $8.8g$ of CO_2 at $31.3^\circ C$ and 1 bar pressure. $\left(R = 0.083\text{bar}LK^{-1}mol^{-1}\right)$

Watch Video Solution

16. $2.9g$ of a gas at $95^\circ C$ occupied the same volume as $0.184g$ of hydrogen at $17^\circ C$ at same pressure What is the molar mass of the gas ? .

Watch Video Solution

17. A mixture of dihydrogen and dioxygen at one bar pressure contains 20% by weight of dihydrogen. Calculate the partial pressure of dihydrogen.

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18. What would be the SI unit for the quantity pV^2T^2/n?

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19. In terms of Charles' law, explain why $-273^\circ C$ is the lowest possible temperature?

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20. Critical temperature of carbon dioxide and water are $31.1^{\circ}C$ and $-81.9^{\circ}C$ respectively. Which of these has stronger intermolecular forces and why?

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21. Explain the physical significance of vanderWaals parameters.

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Ncert Exemplar Problems Multiple Choice Questions I

1. A person living in shimla observd that cooking without using pressure cooker takes more time. The reason for this observation is that at high altitude

A. pressure increases

B. temperature decreases

C. pressure decreases

D. temperature increases

Answer: C

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2. Which of the following property of water can be used to explain the spherical shape of rain droplets ?

A. viscosity

B. surface tension

C. critical phenomena

D. pressure

Answer: B

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3. A plot of volume (V) versus temperature (T) for a gas at constant pressure is a straight line passing through the origin. The plots at different values of pressure are shown in Fig. 5.57. Which of the following order of pressure is correct for this gas ?

A. $p_1 > p_2 > p_3 > p_4$

B. $p_1 = p_2 = p_3 = p_4$

C. $p_1 < p_2 < p_3 < p_4$

D. $p_1 < p_2 = p_3 < p_4$

Answer: C

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4. the interaction energy of London force is inversely proportional to sixth power of the distance between two interaction particles but their mahnitude depends upon

A. charge of intercting particles

B. mass of interacting particles

C. polarisability of interacting particles

D. strength of permanent dipoles in the particles

Answer: C

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5. Dipole-dipole forces act between the molecules possessing permanent dipole. Ends of dipoles possess 'partial charges'. The partial charge is

A. more than unit electronic charge

B. equal to unit electronic charge

C. less than unit electronic charge

D. double the unit electronic charge

Answer: C

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6. the pressure of a $1:4$ mixture of dihydrogen and dioxygen enclosed in a vessel is one atmosphere. What would be the partial pressure of dioxygen ?

A. 0.8×10^5 atm

B. $0.008 Nm^{-2}$

C. $8 \times 10^4 Nm^{-2}$

D. 0.25 atm

Answer: C

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7. As the temperature increases, average kinetic energy of molecules increases. What would be the effect of increase of temperature on pressure provided the volume is constant ?

A. increases

B. decreases

C. remains same

D. becomes half

Answer: A

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8. Gases posses characteristic critical temperature which depends upon the magnitude of intermolecular forces between the particles. Following are the critical temperatures of some gases.

Gases	H_2	He	O_2	N_2
Critical temperature in kelvin	33.2	5.3	154.3	126

From the above data what would be the order of liquefaction of these gases ? Start writing the order from the gas liquefying first

A. H_2. He, O_2, N_2

B. He, O_2, H_2, N_2

C. N_2, O_2, He, H_2

D. O_2, N_2, H_2, He

Answer: D

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9. The SI unit of viscosity coefficient is

A. Pascal

B. Ns m^{-2}

C. km^{-2}s

D. N m^{-2}

Answer: B

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10. Atmospheric pressure recorded in different citie are as follows

Cities	Shimla	Bangalore	Delhi	Mumbai
p in N/m^2	1.01×10^5	1.2×10^5	1.02×10^5	1.21×10^5

Consider the above data mark the place at which liquid will boil first.

A. Shimla

B. Bangalore

C. Delhi

D. Mumbai

Answer: A

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11. Which curve in Fig. 5.58 represents the curve of ideal gas ?

A. B only

B. C and D only

C. E and F only

D. A and B only

Answer: A

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12. Increase in kinetic energy can overcome intermolecular forces of attraction. How will the viscosity of liquid be affected by the increase in temperature ?

A. Increase

B. No effect

C. Decrease

D. No regular pattern will be followed

Answer: C

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13. How does the surface tension of a liquid vary with increase in temperature ?

A. Remains same

B. Decreases

C. Increases

D. No regular pattern is followed

Answer: B

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Multiple Choice Questions Ii

1. With regard to the gaseous state of matter which of the following statemen are correct ?

A. Complete order of molecules

B. Complete disorder of molecules

C. Random motion of molecules

D. Fixed position of molecules

Answer: B::C

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2. Which of the following figures does not represent 1 mole of dioxygen gas at STP ?

A. 16 grams of gas

B. 22.7 litres of gas

C. 6.022×10^{23} dioxygen molecules

D. `11.2 litres of gas

Answer: A::D

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3. Under which of the following conditions applied together, a gas deviates most from the ideal behaviour ?

A. Low pressure

B. High pressure

C. Low temperature

D. High temperature

Answer: B::C

Watch Video Solution

4. Which of the following changes decrease the vapour pressure of water kept in a sealed vessel ?

A. Decreasing the quantity of water

B. Adding salt to water

C. Decreasing the volume of the vessel to one half

D. Decreasing the temperature of water

Answer: B::D

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Short Answer Questions

1. If 1 g of each of the following gases are takes at STP, which of the gases will occupy (a) greatest volume and (b) smallest volume ?

Co, H_2O, CH_4, NO

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2. Physical properties of ice, water and steam are very different. What is the chemical composition of water in all the three states ?

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3. The behaviour of matter in different state is governed by various physical law. According to you, what are the factors that determine the state of matter ?

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4. Use the information and data given below to answer the question (a) to (c),

Stronger intermolecular forces result in higher boiling point. Strength of London forces increases with the number of electrons in the molecule.

Boiling point of HF, HCl, HBr and HI are 293 K, 189 K, 206 K and 238 K respectively.

(a) which type of intermolecular forces are present in the molecules HF, HCl, HBr and HI ?

(b) Looking at the trend of boiling points of HCl, HBr and HI, explain out of dipole-dipole interaction and London interaction, which one is predominant here.

(c) Why is boiling point of hydrogen fluoride highest while that of hydrogen chloride lowest ?

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5. What will be the molar volume of nitrogen and argon at 273.15 K and 1 atm ?

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6. A gas that follows Boyle's law, Charle's law and Avogadro's law is called an ideal gas. Under what conditions a real gas would behave ideally ?

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7. Two different gases 'A' and 'B' are filled in separate containers of equal capacity under the same condition of temperature and pressure. On increasing the pressure

slightly the gas 'A' liquefies but gas B does not liquify even on applying high pressure until it is cooled. Explain this phenomenon.

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8. Value of universal gas constant (R) is same for all gases. What is its physical significance ?

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9. One of the assumptions of kinetic theory of gases states that "there is no force of attraction between the molecules of a gas". How far is this statement correct ? Is it possible to liquefy an ideal gas ? Explain.

Watch Video Solution

10. the magnitude of surface tension of liquid dpends on the attractive forces between the molecules. Arrange the following in increasing order of surface tension :

Water, alcohol (C_2H_5OH) and hexane $\left[CH_3(CH_2)_4CH_3)\right]$.

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11. Pressure exerted by saturated water vapour is called aqueous tension. What correction term will you apply to the total pressure to obtain pressure of dry gas ?

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12. Name the energy which arises due to motion of atoms of molecules in a body. How is this energy effected when the temperature is increased ?

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13. Name two intermolecular forces that exist between HF molecules in liquid state.

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14. One of the assumptions of kineti theory of gases is that there is no force of attraction between the molecules of a gas.

State and explain the evidence that shows that the assumption is not applicable for real gases.

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15. Compressibility factor, Z of a gas is given as $Z = \frac{pV}{nRT}$

(i) What is the value of Z for an ideal gas ?

(ii) For real gas what will be the effect on value of Z above boyle's temperature ?

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16. The critical temperature (T_c) and critical pressure (p_c) of CO_2 are $30.98^\circ C$ and 73 atm respectively. Can $CO_2(g)$ be liquefied at $32^\circ C$ and 80 atm pressure ?

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17. For real gases the relation between p, V and T is given by c=van der Waal's equation

$$\left(p+\frac{an^2}{V^2}\right)(V-nb)=nRT$$

where, 'a' and 'b' are van der Waal's constanrs, 'nb' is approximately equal to the total volume of the molecules of a gas. 'a' is the measure of magnitude of intermolecular attraction.

(i) Arrange the following gases in the increasin order of 'b'. give reason.

O_2, CO_2, H_2, He

(ii) Arrange the following gases in the decreasing order of magnitude of 'a'. Give reason.

CH_4, O_2, H_2

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18. The relation between pressure exerted by an ideal gas (p_{ideal}) and observed pressure (p_{real}) is given by the equation

$$p_{\text{ideal}} = p_{\text{real}} + \frac{an^2}{V^2}$$

If pressure is taken in N m^{-2}, number of moles in mol and volume in m^3, calculate the unit of 'a'. What will be the unit of 'a' when pressure is in atmosphere is in atmosphere and volume in dm^3 ?

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19. Name two phenomena that can be explained on the basis of surface tension.

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20. Viscosity of a liquid arises due to strong intermolecular forces existing between the molecules. Stronger the intermolecular forces, greater is the viscosity. Name the intermolecular forces existing in the following liquids and arrange them in the increasing order of their viscosities. Also give reason for the assigned order in one line.

water, hexane $(CH_3CH_2CH_2CH_2CH_2CH_3)$, glycernine $(CH_2OHCH(OH)CH_2OH)$

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21. Explain the effect of increasing the temperature of a liquid, on intermolecular forces operating between its

particles. What will happen to the viscosity of a liquid if its temperature is increased ?

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22. The variation of pressure with volume of the gas at different temperature can be graphically represented as shown in Fig. 5.60.

On the basis of this graph, answer the following questions:

(i) How will the volume of gas change if its pressure is increased at constant temperature ?

(ii) At a constant pressure, how will the volume of a gas change if the temperature is increased from 200 K to 400 K ?

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23. Pressure versus volume graph for a real gas and an ideal gas are shown in Fig. 5.62. Answer the following questions on the basis of this graph.

(i) Interpret the behaviour of real gas with respect to ideal gas at low pressure.

(ii) Interpret behaviour of real gas with respect gas with respect to ideal gas at high pressure.

(iii) Mark the pressure and volume by drawing a line at the point where real gas behaves as an ideal gas.

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Assertion And Reason Type Questions

1. Assertion (A) Three states of matter are the result of balance between intermolecular forces and thermal energy of the molecules.

Reason (R) Intermolecular forces tend to keep the molecules together but thermal energy of molecules tends to keep tham apart.

A. Both A and R are true and R is the correct explanation of A.

B. Both A and R are true R is not the correct explanation of A.

C. A is true but R is false.

D. A is false but R is true.

Answer: A

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2. Assertion : — At constant temperature PV vs V plot for real gas is not a straight line.

Reason : — At high pressure, all gases have $Z > 1$ but at low pressure most gases have $Z < 1$

A. Both A and R are true and R is the correct explanation of A.

B. Both A and R are true R is not the correct explanation of A.

C. A is true but R is false.

D. A is false but R is true.

Answer: B

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3. Assertion (A) The temperature at which vapour pressure of a liquid is equal to the external pressure is called boiling temperature.

Reason (R) At high altitude atmospheric pressure is high.

A. Both A and R are true and R is the correct explanation of A.

B. Both A and R are true R is not the correct explanation of A.

C. A is true but R is false.

D. A is false but R is true.

Answer: C

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4. Assertion (A) Gases do not liquefy above their critical temperature, even on applying high pressure.

Reason (R) Above critical temperature, the molecular speed is high and intermolecular attractions cannot hold the molecules together because they escape because of high speed.

A. Both A and R are true and R is the correct explanation of A.

B. Both A and R are true R is not the correct explanation of A.

C. A is true but R is false.

D. A is false but R is true.

Answer: A

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5. Assertion (A) At critical temperature liquid passes into gaseous state imperceptibly and continuously.

Reason (R) The density of liquid and gaseous phase is equal to critical temperature.

A. Both A and R are true and R is the correct explanation of A.

B. Both A and R are true R is not the correct explanation of A.

C. A is true but R is false.

D. A is false but R is true.

Answer: A

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6. Assertion (A) Liquids tend to have maximum number of molecules at their surface.

Reason (R) Small liquid drops have spherical shape.

A. Both A and R are true and R is the correct explanation of A.

B. Both A and R are true R is not the correct explanation of A.

C. A is true but R is false.

D. A is false but R is true.

Answer: D

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Long Answer Questions

1. Isotherms of carbon dioxide at various temperatures are represented in Fig. 5.64. Answer the following questions :

(i) In which state will CO_2 exist between the points a and b at temperature T_1 ?

(ii) At what point will CO_2 start liquefying when temperature is T_1 ?

(iii) At what point will CO_2 be completely liquefied when temperature is T_2.

(iv) Will condensation take place when the temperature is T_3 .

(V) What portion of the isotherm at T_1 represent liquid and gaseous CO_2 at equilibrium ?

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2. The variation of vapour pressure of different liquids with temperature is shown in Fig. 5.65 (on the next page) :

(i) Calculate graphically boiling points of liquids A and B.

(ii) If we take liquid C in a closed vessel and heat it continuosly, at what temperature will it boil ?

(iii) At high altitude, atmospheric pressure is low (say 600 mm Hg). At what temperature will liquid D boil?

(iv) Pressure cooker is used for cooking food at hill station. Explain in terms of vapour pressure why is it so ?

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3. Why does the boundary between liquid phase and gaseous phase disappear on heating a liquid upto critical

temperature in a closed vessel ? In this situation what will be the state of the substance ?

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4. Why does sharp glass edge become smooth on heating it upto its melting point in a flame ? Explain which property of liquids is responsible for this phenomenon.

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5. Explain the term 'laminar flow'. Is the velocity of molecules same in all the layers in Laminar flow ? Explain you answer.

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Additional Questions Very Short Answer Questions Differentiating Three States Of Matter And Intermolecular Forces

1. What do you understand by ‘triple point’ of a substance?

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2. A substance has a definite volume but no 'definite shape'. State whether this substance is a solid, a liquid or a gas.

Watch Video Solution

3. What is the binding force between molecules if a subsatance is a gas under ordinary conditions of

temperature and pressure?

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4. What is the molar volume of a gas at SATP condition ?

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Additional Questions Very Short Answer Questions Measurement Of Mass Volume Temperature And Pressure Gas Laws And Ideal Gas Equation

1. What is the equation of state of an ideal gas for n moles ?

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2. What is the value of the gas constant in S.I. units ?

Watch Video Solution

3. How is the pressure of a gas related to its density at a particular temperature ?

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Additional Questions Very Short Answer Questions Kinetic Theory Of Gases Kinetic Energy And Molecular Speeds

1. How is the average speed of gas molecules related to temperature of the gas ?

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2. If the root mean square speed of gas molecules at a particular temperature is 10,000 cm s^{-1}, what will be the average speed and most probable speed at the same temperature?

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Additional Questions Very Short Answer Questions Behaviour Of Real Gases And Van Der Waals Equation

1. What is compressibility factor ? What is its value for an ideal gas?

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2. How is compressibility factor expressed in terms of molar volume of the real gas and that of the ideal gas ?

Watch Video Solution

3. What is Boyle temperature?

Watch Video Solution

4. What is the equation of state for real gases ?

Watch Video Solution

5. Why a liquid boils at a lower tempetature at the top of a mountain than at sea level ?

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Additional Questions Very Short Answer Questions Liquefaction Of Gases And Critical Temperature

1. What do you understand by 'continuity of state' in gases and liquids ?

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2. What is the difference between gas and vapour ?

Watch Video Solution

Watch Video Solution

Additional Questions Very Short Answer Questions Liquid State And Properties Of Liquids Vapour Pressure Surface Temsion And Viscosity

1. S.I. Unit of surface tension is:

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2. What do you understand by laminar flow of a liquid ?

Watch Video Solution

3. Out of methanoul and water which has higher viscosity and why ?

Watch Video Solution

4. What is the unit of coefficient of viscosity?

Watch Video Solution

5. What is the SI unit of coefficient of viscosity? How is it related to poise?

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Additional Questions Short Answer Questions Differentiating Three States Of Matter And Intermolecular Forces

1. On the basis of intermolcular forces and thermal energy ,explain why

(i) a solid has rigidity but liquids do not have rigidity?

(ii) gases have high compressibility but liquids and solids have poor compressibility ?

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2. What is the difference between barometer and manometer?

Watch Video Solution

3. What is the cause of gas pressure ? How is it measured ?

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4. Define Boyle's law. How is it represented mathematically ?

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5. What type of curve are obatained when at constant temperature, we plot

(i) P vs 1/V (ii) PV vs P (iii) V vs P

Watch Video Solution

6. Define Charles's law. Give its mathematical formulae.

Watch Video Solution

7. Define Absolute zero. Can this temperature be attained in actual practice? Give reason for your answer.

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8. What is the value of the gas constant in S.I. units ?

Watch Video Solution

9. Derive the relationship between pressure, temperature and density of a gas (i.e. M=d RT/P).

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10. Define Dalton's law of partial pressures. Using this law, how is the pressure of dry gas determined ?

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11. Graham's Law of Diffusion

Watch Video Solution

12. List the important postulates of kinetic theory of gases.

Watch Video Solution

13. Define most probable speed, average speed and root mean square speed of a gas. How are they related to each other ?

Watch Video Solution

14. Write kinetic gas equation. How does Boyle's law follow from it ?

Watch Video Solution

15. Write kinetic gas equation. How does Charles' law can derive from it ?

Watch Video Solution

16. What is 'compressibility factor' ? What is its value for 'an ideal gas' ? How does it help to understand the extent of deviation of a gas from ideal behaviour ?

Watch Video Solution

17. Why do real gases show deviation from ideal behaviour ? Write van der Waals equation for n moles of a gas.

Watch Video Solution

18. What are the untis of van der Waals constant 'a' and 'b' ? What is their signifiacance ?

Watch Video Solution

19. Why is the effect of temperature more important for the liquefaction of gases ? Define critical temperature and critical pressure.

Watch Video Solution

20. Briefly describe the importance fo critical temperature. How can it be correlated with van der Waals constant 'a' ?

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21. Explain the statement 'Liquid state is intermediate between the gaseous state and the solid state.

Watch Video Solution

22. Give reasons for the following :-

(i) Liquids have a define volume but no definite shape.

(ii) Liquids have higher density than gases.

(iii) Liquids are much less compressible than gases.

(iv) Liquids posses fluidity.

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23. Define vapour pressure, boiling point and heat of vaporisation.

Watch Video Solution

24. The difference between boiling and evaporation is that

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25. What is the effect of temperature on :

(a) Density , (b) Surface tension , (c) Viscosity and (d) Vapour pressure of a liquid ?

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Additional Questions Long Answer Questions

1. What is the difference between solid and liquid states ?

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2. On the basis of intermolecular forces and thermal energy, explain why substances exist in three different states.

Watch Video Solution

3. How are the following measured ?

(i) atmospheric pressure (ii) pressure of a gas.

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4. State and explain Boyle's law. How is the law verified graphically ? What is the significance of this law to the mountanineers ?

Watch Video Solution

Watch Video Solution

5. Briefly explain Pressure-Temperature law.

Watch Video Solution

6. What is ideal gas equation ? How can it be derived ? Also express it in terms of density of the gas.

Watch Video Solution

7. Why do real gases deviate from ideal behaviour ? Write the equation of state for real gases (van der Waals equation).

Watch Video Solution

8. Briefly explain the term "vapour pressure". What are the factors on which the vapour pressure of a liquid depends ?

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Analytical Questiona And Problems Questions

1. Why liquids have a definite volume but no definite shape?

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2. A gas is filled into a bulb connected to an open limb manometer. The level of mercury in the open arm is 2.1 cm

lower than that in the other arm of the manometer. The atmospheric pressure is 740 mm. What is the pressure of the gas?

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3. N_2O and CO_2 have the same rate of diffusion under same conditions of temperature and pressure. Why ?

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4. What would have happened to the gas if the molecular collisions were not elastic ?

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5. Why in the case of hydrogen and helium, the compressibility factor is always greater than 1 and increases with increase of pressure?

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6. At a particular temperature why is the vapour pressure of acetone less than that of ether?

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7. Why vegetables are cooked with difficulty at a hill station?

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8. Why does the boiling temperature of liquid becomes constant once it starts boiling?

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9. Why liquids diffuse slowly as compared to gases?

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10. One way of writing the equation of state for real gases is

$$PV = RT\left[1 + \frac{B}{V} + \ldots\right]$$

where B is a constant. Derive an approximate expression for B in terms of the van der Waals constants a and b.

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11. Write expression for Boyle's temperature and critical temperature in terms of van der Waals constants. Which one is larger for a particular gas?

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12. Write expressions for Boyle temperature and inversion temperature of a gas in terms of van der Waals constants. How are the two related to each other ?

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Analytical Questiona And Problems Questions Problems

1. A balloon filled with helium rises to a certain height at which it gets fully inflated to a volume of 10^5 litres. If at this altitude, temperature and atmospheric pressure are 268 K and 2×10^{-3} atm respectively, what weight of helium will be required to fully inflate the balloon ?

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2. At room temperature, ammonia gas at 1 atm pressure and HCl gas at pressure P atm are allowed to effuse through idential pin holes from opposite ends of a glass tube of 1 meter length and of uniform area of cross-section. NH_4Cl is first formed at a distance of 60 cm from the end through which HCl gas was sent in. Calculate the value of P.

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3. A vessel is filled with a mixture of oxygen and nitrogen. At what ratio of partial pressures will the mass of gases be identical?

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4. A gas bulb of 1 litre capacity contains 2.0×10^{21} molecules of nitrogen exerting a pressure of $7.57 \times 10^{3} \ \mathrm{N} \ m^{-2}$. Calculate the root mean square (r.m.s) speed and the temperature of the gas molecules.

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5. 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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6. If the volume occupied by CO_2 molecules is negligible, then calculate the pressure exerted by one mole of CO_2 gas at 273 K (a=3.592 atm $\text{litre}^{-2} mol^{-2}$)

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7. One mole of nitrogen gas at 0.8 atm takes 38 s to diffuse through a pinhole, whereas one mole of an unknown compound of xenon with fluorine at 1.6 atm takes 57s to diffuse through the same hole. Calculate the molecular formula of the compound.

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8. 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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9. The compression factor (compressibility factor) for $1mol$ of a van der Waals gas at $0^\circ C$ and $100atm$ pressure is found to be 0.5. Assuming that the volume of a gas molecule is neligible, calculate the van der Waals constant a.

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10. Assuming the same pressure in each case calculate the mass of hydrogen requied to inflate a ballon to a certain volume V at $100^\circ C$ if $3.5g$ helium is required to inflate the balloon to half the volume V at $25^\circ C$.

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11. In a hospital, an oxygen cylinder holds 10 L of oxygen at 200 atm pressure. If a patient breathes in 0.50 mL of oxygen at 1.0 atm with each breath, for how many breaths the cylinder will be sufficient. Assume that all the data is at $37^{\circ} C$

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12. A cylinder of 20.0 L capacity contains 160 g oxygen gas at $25^{\circ} C$. What mass of oxygen must be released to reduce the pressure of the cylinder to 1.2 atm ?

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13. 50 litre of dry N_2 is passed through 36 g H_2O at $27^\circ C$. After the passage of the gas, the mass of water was reduced to 34.80 g. Calculate the aqueous tension of water at $27^\circ C$.

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14. A 5-L vessel contains 1.4 g of nitrogen. When heated to 1800 K, 30% of molecules are dissociated into atoms. Calculate the pressure of the gas at 1800 K.

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15. The volume expansivity of a gas under constant pressure is 0.0037. Calculate its volume at- $100^\circ C$ if its volume at

$100^\circ C$ is $685 cm^3$.

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16. A 2.0 L container at $25^\circ C$ contain 1.25 mol of O_2 and 3.2 mol of C.

(a) What is the initial pressure in the flask ?

(b) If the carbon and oxygen react as completely as possible to form CO, what will be the final pressure in the container?

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17. On a certain humid day, the mole fraction of water vapour in air at $25^\circ C$ is 0.0287. If total pressure of air is 0.977 bar,

calculate the partial pressure of water vapour in air and relative humidity if vapour pressure of water at $25^{\circ} C$ is 0.0313 bar.

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18. An open vessel at $27^{\circ} C$ is heated until $3/5$ of the air in it is expelled. Assuming that the volume of the vessel remains constant, find the temperature to which the vessel has been heated.

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19. Two flacks of equal volume connected by a narrow tube of negligible volume are filled with N_2 gas. When both are

immersed in boiling water, the gas pressure inside the system is $0.5atm$. Calculate the pressure of the system when one of the flasks is immersed in an ice-water mixture keeping the other in boiling order.

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20. What is the difference in

pressure between the top and bottom of a vessel 76 cm deep at $27^\circ C$ when filled with

(i) water

(ii) mercury ?

Density of water at $27^\circ C$ is 0.990 g $0.990 \quad gcm^{-3}$ and that of mercury is $13.60 \quad \mathrm{g\ cm^{-3}}$.

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21. Calculate the critical constants of a gas whose van der Waals constants are :

$a = 0.751 \ \ \mathrm{L}^2 \ \ \mathrm{atm} \ \ mol^{-2}$ and $b = 0.0226 \ \ \mathrm{L\,mol}^{-1}$.

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22. A mixture of CO and CO_2 is found to have a density of $1.50 \ \ \mathrm{g} \ \ L^{-1}$ at $20^\circ C$ and 740 mm pressure. Calculate the composition of the mixture.

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23. The boiling point of a liquid is $68.9^\circ C$. Calculate its aproximate critical temperature.

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24. Assuming CO_2 to be van der Waals gas, calculate its Boyle temperature. Given $a = 3.59 \ \mathrm{L}^2 \ \mathrm{atm} \ mol^{-2}$ and $b = 0.0427 \ \mathrm{L} \ mol^{-1}$.

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25. A gaseous mixture of three gases A, B and C has a pressure of 10 atm. The total number of moles of all the gases is 10. If the partial pressure of A and B are 3.0 and 1.0 atm respectively and if C has a mol/wt. of 2.0. what is the weight of C in g present in the mixture ?

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Competition Focus Differentiating Three States Of Matter And Intermolecular Forces

1. Dipole-induced dipole interaction are present in which of the following pairs

A. H_2O and alcohol

B. Cl_2 and CCl_4

C. HCl and He atoms

D. SiF_4 and He atoms

Answer: C

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2. The intermolecular interaction that is dependent on the inverse cube of distance between the molecules is

A. Ion-ion interaction

B. Ion-dipole interaction

C. London force

D. Hydrogen bond

Answer: D

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Competition Focus Measurement Of Mass Volume Temperature And Pressure Gas Laws And Ideal Gas Equation

1. Which of the following represents the highest pressure?

A. 1 atmosphere

B. 1 bar

C. 10 pounds per square inch

D. 1000 pascals or Nm^{-2}

Answer: A

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2. Equation for Boyle's law is

A. $\frac{dP}{P} = \frac{dV}{V}$

B. $\frac{dP}{P} = +\frac{dV}{V}$

C. $\frac{d^{23}P}{P} = -\frac{dV}{dT}$

D. $\frac{d^2P}{P} = +\frac{d^2V}{dT}$

Answer: A

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3. Which of the following is not correct for Boyle's Law at $27^\circ C$?

A. P=380 mm Hg, V=100 mL

B. P=1 atm, V=0.05 L

C. P=1 atm, V=0.5 dm^3

D. P=190 mm Hg, V=0.2 dm^3

Answer: C

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4. In order to increase the volume of a gas by 10% , the pressure of the gas should be

A. decreased by 10%

B. decreased by 1%

C. increased by 10%

D. increased by 1%

Answer: A

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5. What will be the partial pressures of He and O_2 respectively if 200 ml of He at 0.66 atm pressure and 400 ml of O_2 at 0.52 atm pressure are mixed in 400 ml vessel at $20^\circ C$?

A. 0.33 and 0.56

B. 0.33 and 0.52

C. 0.38 and 0.52

D. 0.25 and 0.45

Answer: B

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6. A bubble of gas released at the bottom of a lake increases to eight times its original volume when it reaches the surface. Assuming that atmospheric pressure is equivalent to the pressure exerted by a column of water 10 m height, the depth of the lake is

A. 80 m

B. 90 m

C. 40 m

D. 70 m

Answer: D

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7. A J-shaped tube with smaller end closed and longer end open was taken. Mercury was added into it till the level of mercury in both the limbs was same. Volume of air enclosed in the closed end was found to be 2.4 mL. Now more mercury was added and the air enclosed in the closed ed reduced to 1.9 mL. Now, the difference in the level of the two limbs will be

A. 43 cm

B. 5 cm

C. 10 cm

D. 20 cm

Answer: D

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8. Some mercury is poured into a capillary tube of uniform bore and one end closed. When the tube is held horizontally, mercury column has a length of 4 cm and air enclosed in the closed end has a length of 10 cm. If the tube is now held vertically, with open end upwards, the length of the air column will be (take atmospheric pressure at the place of experiment to be 760 mm)

A. 10.5 cm

B. 8.5 cm

C. 9.0 cm

D. 9.5 cm

Answer: D

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9. Two gases bulbs A and B are connected by a tube having a stopcock. Bulb A has a volume of $100mL$ and contains H_2 gas . After opening the gas from A to the evacuated bulb B, the pressure falls down by 40%. The volume $(mL)ofB`$ must be

A. 75

B. 150

C. 125

D. 200

Answer: B

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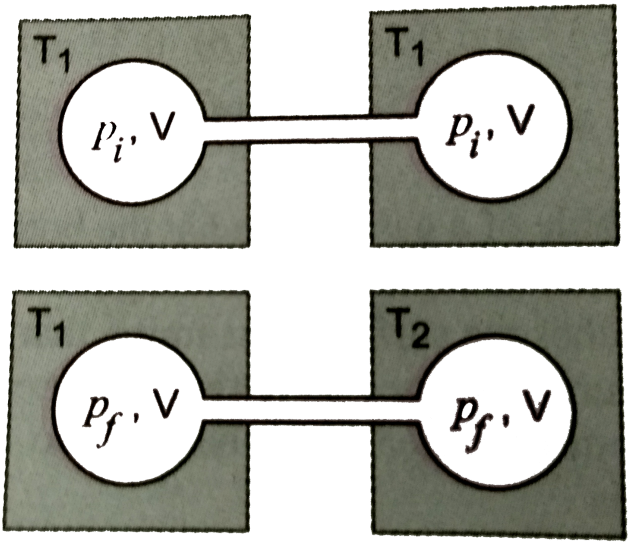
10. Two closed bulbs of equal volume (V) containing an ideal gas initially at pressure p_i and temperature T_1 are connected through a narrow tube of negligible volume as shown in the figure below. The temperature of one of the bulbs is then raised to T_2. The final pressure p_f is



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

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

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

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

Answer: C

View Text Solution

11. Containers A, B and C of equal volume contain oxygen, neon and methane respectively at the same temperature and pressure. The correct increasing order of their masses is

A. $A < B < C$

B. $B < C < A$

C. $C < A < B$

D. $C < B < A$

Answer: D

View Text Solution

12. Average volume available to a molecule in sample of a gas at STP is

A. $1.66 \times 10^{-24} cm^3$

B. $3.769 \times 10^{-20} cm^3$

C. $22400 cm^3$

D. unpredictable

Answer: B

Watch Video Solution

13. Pressure of a mixture of 4 g of O_2 and $2gH_2$ confined in a bulb of 1 litre at $0^\circ C$ is

A. 25.15 atm

B. 31.025 atm

C. 45.215 atm

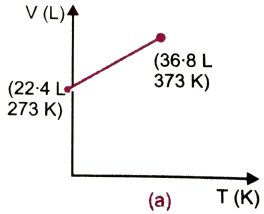
D. 15.210 atm

Answer: A

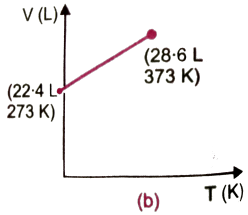
Watch Video Solution

14. Which one of the following volume (V)- temperature (T) plots represents the behaviour of one mole of an ideal gas at one atmosphere?

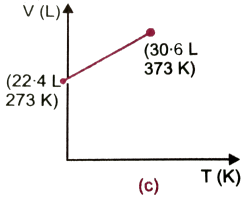
A.



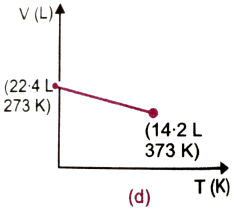
B.



C.



D.



Answer: C

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15. Containers A and B have same gases. Pressure, volume and temperature of A are all twice that of B, then the ratio of number of molecules of A and B are

A. $1:2$

B. $2:1$

C. $1:4$

D. $4:1$

Answer: B

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16. A mixture of argon (Ar) and nitrogen (N_2) has a density of 1.40 g L^{-1} at STP. Mole fraction of N_2 in the mixture is (Given atomic mass of Ar=40)

A. 0.3

B. 0.4

C. 0.5

D. 0.7

Answer: D

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17. The density of a gas is 1.964 g dm^{-3} at 273 K and 76 cm Hg. The gas is

A. CH_4

B. C_2H_6

C. CO_2

D. Xe

Answer: C

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18. If $10^{-4}dm^3$ of water is introduced into a $1.0dm^3$ flask to $300K$ how many moles of water are in the vapour phase when equilibrium is established ? (Given vapour pressure of H_2O at $300K$ is $3170PaR = 8.314JK^{-1}mol^{-1}$) .

A. $4.46 \times 10^{-2}mol$

B. $1.27 \times 10^{-3}mol$

C. $5.5 \times 10^{-3}mol$

D. $1.53 \times 10^{-2}mol$

Answer: B

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19. The pressure exerted by 6.0 g of methane gas in a $0.03m^3$ vessel at $129^\circ C$ is (Atomic masses : C=12.01, H=1.01 and R=8.314 $JK^{-1}mol^{-1}$)

A. 215216 Pa

B. 13409 Pa

C. 41648 Pa

D. 31684 Pa

Answer: C

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20. 2 mole of N_2O_4 (g) is kept in a closed container at 298 K and 1 atmosphere pressure. It is heated to 596 K when 20% by mass of $N_2O_4(g)$ decomposes to NO_2. The resulting pressure is

A. 2.4 atm

B. 1.2 atm

C. 4.8 atm

D. 2.8 atm

Answer: A

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21. What will happen to volume of a bubble of air found under water in a lake where temperature is $15^{\circ}C$ and the pressure is 1.5 atm, if the bubble rises to the surface where the temperature is $25^{\circ}C$ and the pressure is 1.0 atm?

A. Its volume will become greater by a factor of 2.5

B. Its volume will become greater by a factor of 1.6

C. Its volume will become greater by a factor of 1.1

D. Its volume will become smaller by a factor of 0.70

Answer: B

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22. An LPG cylinder containing containing 15 kg butane at $27^{\circ}C$ and 10 atm pressure is leaking. After one day, its pressure decreased to 8 atm. The quantity of the gas leaked is

A. 1 kg

B. 2 kg

C. 3 kg

D. 4 kg

Answer: C

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23. An evacuated vessel weighs 50 g when empty, 144 g when filled with a liquid of density 0.47 g mL^{-1} and 50.5 g when filled with an ideal gas at 760 mm Hg at 300 K. The molar mass of the ideal gas is (Given R=0.082 L atm $K^{-1}mol^{-1}$)

A. 61.575

B. 130.98

C. 87.943

D. 123.75

Answer: A

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24. 28 g of each of the following gases are taken at $27^{\circ}C$ and 600 mm pressures. Which of these will have the least volume?

A. HBr

B. HCl

C. HF

D. HI

Answer: D

View Text Solution

25. The volume of 0.0168 mol of O_2 obtained by decomposition of $KClO_3$ and collected by displacement of

water is 428 ml at a pressure of 754 mm Hg at $25^{\circ}C$. The pressure of water vapour at $25^{\circ}C$ is

A. 18 mm Hg

B. 20 mm Hg

C. 22 mm Hg

D. 245 mm Hg.

Answer: D

View Text Solution

26. Under identical experimental conditions, which one of the following pairs of gases will be most easy to separate by diffusion process ?

A. O_2, N_2

B. O_2F_2

C. H_2, D_2

D. $^{235}U_6, ^{238}UF_6$

Answer: C

View Text Solution

27. 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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28. XmL of H_2 gas effuses through a hole in a container is 5 second. The time taken for the effusion of the same volume of the gas specified below under identical conditions is .

A. 10 seconds : He

B. 20 seconds : O_2

C. 25 seconds : CO

D. 55 seconds : CO_2

Answer: B

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29. A certain gas takes three times as long to effuse out as helium. Its molar mass will be

A. 64 u

B. 9 u

C. 27 u

D. 36 u

Answer: D

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30. A $4:1$ mixture of helium and methane contained in a vessel at 10 bar pressure. During a hole in the vessel, the gas mixture leaks out. The composition of the mixture effusing out initially is

A. $8:1$

B. $8:3$

C. $4:1$

D. $1:1$

Answer: A

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31. $0.5mol$ of H_2, SO_2, and CH_4 is kept in a container. A hole was made in the container. After $3hours$, the order of partial pressure in the container will be

A. $p_{SO_2} > p_{CH_4} > p_{H_2}$

B. $p_{H_2} > p_{SO_2} > p_{CH_4}$

C. $p_{H_2} > p_{SO_2} > p_{CH_4}$

D. $p_{H_2} > p_{CH_4} > p_{SO_2}$

Answer: A

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32. At identical temperature and pressure, the rate of diffusion of hydrogen gas is $3\sqrt{3}$ times that of a hydrocarbon having molecular formula C_nH_{2n-n}. What is the value of n?

A. 1

B. 4

C. 3

D. 8

Answer: B

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33. A $4.0dm^3$ flask containing N_2at4 bar was connected to a $6.0dm^3$ flask containing helium at 6 bar , and the gases were allowed to mix isothermally. The total pressure of the resulting mixture will be

A. 10.0 bar

B. 5.2 bar

C. 1.6 bar

D. 5.0 bar

Answer: B

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34. Equal masses of H_2, O_2 and methane have been taken in a container of volume V at temperature $27^\circ C$ in identical conditions. The ratio of the volume of gases $H_2 : O_2$: methane would be

A. $8:16:1$

B. $16:8:1$

C. $16:1:2$

D. $8:1:2$

Answer: C

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35. Equal masses of He, O_2 and SO_2 are taken in a closed container. The ratio of the partial pressures of gases He, O_2 and SO_2 would be

A. $1:2:8$

B. $8:16:1$

C. $16:2:1$

D. $1:4:16$

Answer: D

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36. Equal moles of hydrogen and oxygen gases are placed in a container with a pin-hole through which both can escape.

What fraction of the oxygen escapes in the time required for one-half of the hydrogen to escape ?

A. $3/8$

B. $1/2$

C. $1/8$

D. $1/4$

Answer: C

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Competition Focus Kinetic Theory Of Gases Kinetic Energy And Molecular Speeds

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

C. $T(N_2) = 2T(H_2)$

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

Answer: C

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2. If the rms speed of gas molecules is $xcms^{-1}$ at a pressure of p atmospheres, then the rms speed at a

pressure of $2p$ atmospheres and constant temperature will be

A. x

B. 2x

C. 4x

D. x/4

Answer: A

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3. As the temperature is raised from $20^\circ C$ to $40^\circ C$ the averge kinetic energy of neon atoms changes by a factor .

A. $1/2$

B. $\sqrt{313/293}$

C. 313/293

D. 2

Answer: C

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4. What is the kinetic energy of 1 g of O_2 at $74^\circ C$?

A. $1.24 \times 10^2 J$

B. $2.24 \times 10^2 J$

C. $1.24 \times 10^3 J$

D. $3.24 \times 10^2 J$

Answer: A

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5. At what temperature will the total kinetic energy of 0.30 mol of helium be same as the total kinetic energy of 0.40 mol of argon at 500 K.

A. 400 K

B. 300 K

C. 533 K

D. 573 K

Answer: C

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6. Which one of the following will have greatest average speed of its molecules ?

A. 0.5 mol of O_2 at 500 K

B. 0.2 mol of CO_2 at 400 K

C. 1.0 mol of He at 200 K

D. 0.4 mol of NH_3 at 300 K

Answer: C

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7. By what factor does the average velocity of a gaseous molecule increase when the temperature (in Kelvin) is

doubled?

A. 1.4

B. 2.0

C. 2.8

D. 4.0

Answer: A

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8. For one mole of an ideal gas, increasing the temperature from $10^{\circ} C$ to $20^{\circ} C$

A. increases the average kinetic energy by two times

B. increases the rms by $\sqrt{2}$ times

C. increased the rms by 2 times

D. increases both the average kinetic energy and rms velocity but not significantly

Answer: D

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9. In the temperature changes from $27^\circ C$ to $127^\circ C$, the relative percentage change in RMS velocity is

A. 1.56

B. 2.56

C. 15.6

D. 82.4

Answer: C

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10. If a gas expands at constant temperature, it indicates that

A. kinetic energy of the molecules decreases

B. pressure of the gas increases

C. kinetic energy of the molecule remains the same

D. number of molecule of the gas increases

Answer: C

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

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

C. $C^* : \overline{C} : C = 1.128 : 1.125 : 1$

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

Answer: D

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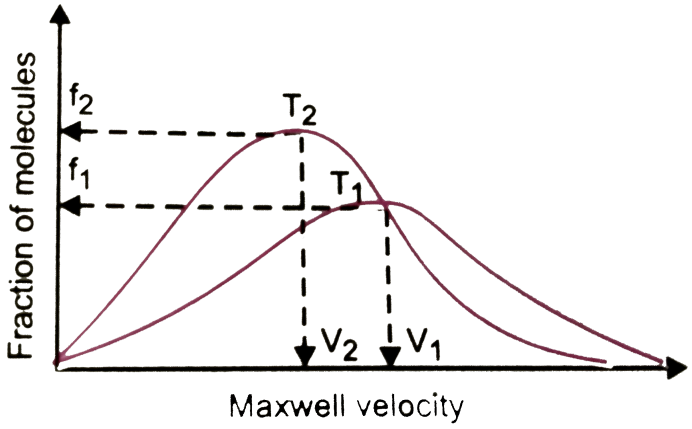
12. Plot of Maxwell's distribution of velocities is given below :



Which of the following is correct about this plot ?

A. $f_1 > f_2$

B. $V_1 < V_2$

C. $T_1 < T_2$

D. $T_1 > T_2$

Answer: D

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Competition Focus Behaviour Of Real Gases And Van Der Waals Equation

1. A gas such as carbon monoxide would be most likely to obey the ideal gas law at

A. low temperature and high pressures

B. high temperature and high pressures

C. low temperature and low pressures

D. high temperatures and low pressures

Answer: D

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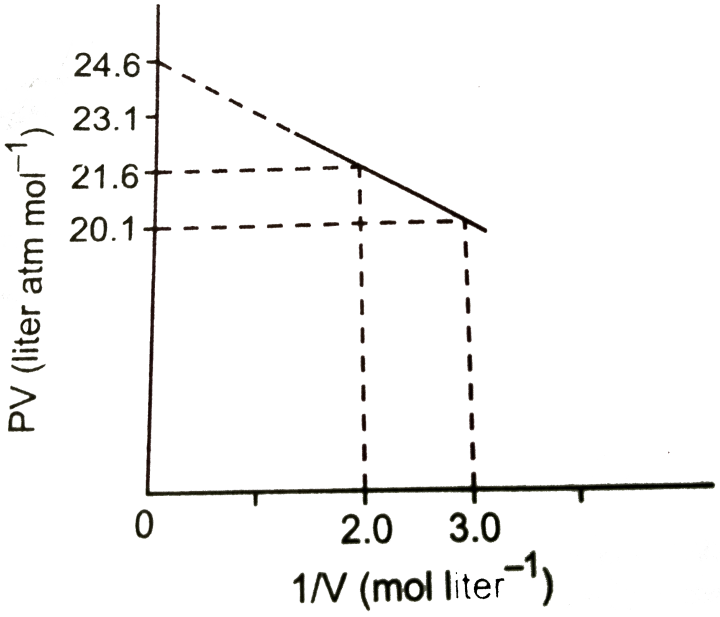
2. For one mole of a van der Waals gas when b=0 and T=300 K, the PV vs 1/V plot is shown below. The value of the van der Waals constant 'a' (atm $litre^2 mol^2$) is



A. 1.0

B. 4.5

C. 1.5

D. 3.0

Answer: C

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3. What is the pressure of 2 mole of NH_3 at $27^\circ C$ when its volume is 5 lit. in Van der Waal's equation ? $(a = 4.17, b = 0.03711)$

A. 10.33 atm

B. 9.33 atm

C. 9.74 atm

D. 9.2 atm

Answer: B

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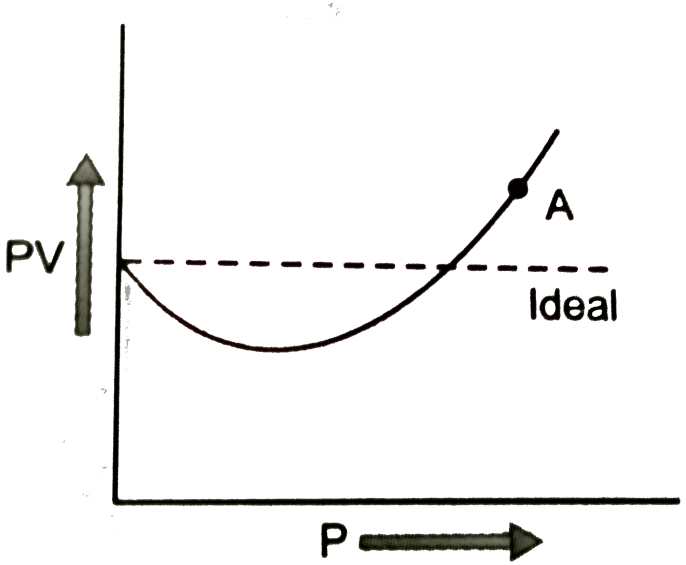
4. The isotherm obtained for CO is as follows :



The compressibility factor for the gas at point A will be

A. $\left(1-\frac{b}{V}\right)$

B. $\left(1+\frac{b}{V}\right)$

C. $\left(1+\frac{b}{RT}\right)$

D. $\left(1+\frac{a}{RTV}\right)$

Answer: B

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5. For real gases, van der Waals' equation is written as

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

where a and b are van der Waals' constants.

Two sets of gases are:

$(I) O_2, CO_2, H_2$ and $He (II) CH_4, O_2$ and O_2 and H_2

The gases given in set I in increasing order of b and gases given in set II in decreasing order of a are arranged below.

Select the correct order from the following:

A. $(I) H_2 < He < O_2 < CO_2 (II) CH_4 > O_2 > H_2$

B. $(I) H_2 < O_2 < CO_2 (II) O_2 > CH_4 > H_2$

C. $(I)He < H_2 < CO_2 < O_2 (II) CH_4 > H_2 > O_2$

D. $(I)O_2 < He < H_2 < CO_2 (II) H_2 > O_2 > CH_4$

Answer: A

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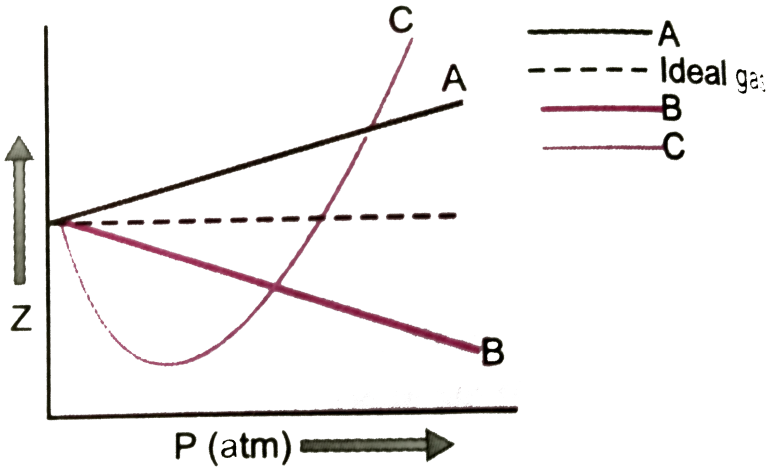
6. The given graph represents the variation of Z (compressibility factor $= \frac{PV}{nRT}$) versus P, for three real gases A,B and C. Identify incorrect statement.



A. For the gas A, a=0 and its dependent on P is linear at all pressures.

B. For the gas B, b=0 and it dependence on P is linear at all pressures.

C. For the gas C, which is typical real gas for which neither a=0 nor b=0. By knowing the minima 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: C

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7. Under critical conditions, the compressibility factor for a gas is .

A. $\frac{3}{8}$

B. $\frac{8}{3}$

C. $\frac{3}{4}$

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

Answer: A

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8. a' and 'b' are van der Waals' constants for gases Chlorine is more easily liquefied than ethane because .

A. a and b for $Cl_2 < a$ and b for C_2H_6

B. a for $Cl_2 < a$ for C_2H_6 but b for $Cl_2 > b$ for C_2H_6

C. a for $Cl_2 > a$ for C_2H_6 but b for $Cl_2 < b$ for C_2H_6

D. a and b for $Cl_2 > a$ and b for C_2H_6

Answer: C

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9. Maximum deviation from ideal gas is expected from

A. H_2(g)

B. N_2(g)

C. CH_4(g)

D. NH_3(g)

Answer: D

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

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

B. $Z = 1 + \frac{RT}{Pb}$

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

D. $Z = 1 - \frac{Pb}{RT}$

Answer: C

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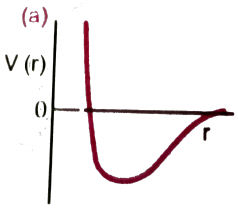
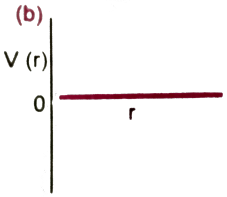
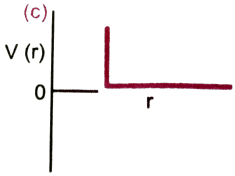
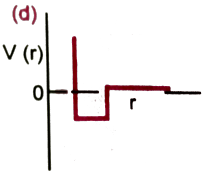
11. One mole of a monoatomic real gas satisfies the equation $p(V-b)=RT$ where b is a constant. The relationship of interatomic potential $V(r)$ and interatomic distance r for gas is given by

A. 

B. 

C. 

D. 

Answer: A

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12. The correction factor 'a' to the ideal gas equation corresponds to

A. density of the gas molecules

B. volume of the gas molecules

C. electric field present between the gas molecules

D. forces of attraction between the gas molecules

Answer: D

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Competition Focus Liquefaction Of Gases And Critical Temperature

1. The correct order of liquefaction of the gases NH_3, CO_2, SO_2 and HCl is

A. $NH_3 > CO_2 > HCl > SO_2$

B. $CO_2 > NH_3 > SO_2 > HCl_2$

C. $HCl > CO_2 > NH_3 > SO_2$

D. $SO_2 > NH_3 > HCl > CO_2$

Answer: D

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2. Given van der Waals constant for NH_3, H_2, O_2 and CO_2 are respectively $4.17, 0.244, 1.36$ and 3.59, which one of the following gases is most easily liquefied?

A. NH_3

B. H_2

C. O_2

D. CO_2

Answer: A

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3. Which one of the following gases has the highest critical temperature ?

A. Nitrogen

B. Ammonia

C. Water vapour

D. Carbon dioxide

Answer: C

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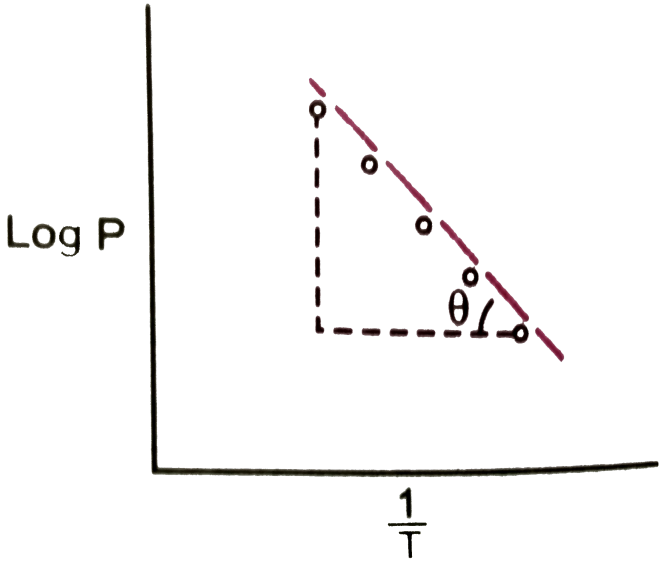
Competition Focus Liquid State And Properties Of Liquid

1. The variation of vapour pressure with temperature for a liquid was studied by plotting log P versus 1/T as shown in the Fig. The slope of the line $(\tan\theta)$ was found to be -2 K.

Then latent heat of vaporisation of the given liquid is



A. $4.606 \quad \text{cal mol}^{-1}$

B. $2.303 \quad \text{cal mol}^{-1}$

C. $9.212 \quad \text{cal mol}^{-1}$

D. $8.314 \quad \text{cal mol}^{-1}$

Answer: C

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2. Surface tension of water is 73 dyne cm^{-1} at $20^{\circ}C$. If surface area is increased by $0.10 \ \mathrm{m}^2$, work done will be

A. 73 ergs

B. 730 ergs

C. 7300 ergs

D. 73000 ergs

Answer: D

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3. Which values can be obtained from the information represented by the vapour pressure curve of a liquid ?

Normal boiling point

Normal freezing point

Enthalpy of vaporisation

A. A only

B. A & B only

C. A & C only

D. A,B & C.

Answer: B

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4. Choose the incorrect statement in the following :

A. Surface tension is the force acting per unit length perpendicular to the line drawn on the surface of the

liquid

B. Surface tension of a liquid increases with increase in temperature

C. The SI unit of surface tension in J m^{-2}

D. Viscosity is a measure of resistance for the flow of liquid

Answer: B

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Competition Focus Miscellaneous

1. If the collision frequency of a gas at 1 atm pressure is Z, then its collision frequency at 0.5 atm is

A. 0.25 Z

B. 0.50 Z

C. Z

D. 2Z

Answer: A

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2. The temperature at which the second virial coefficient of a real gas is zero is called .

A. critical temperature

B. Boyle temperature

C. inversion temperature

D. eutetic point

Answer: B

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3. If volume of the gas is very large, then the second virial coefficient B in virial equation is

A. $\left(b+\frac{a}{RT}\right)$

B. $\left(b-\frac{a}{RT}\right)$

C. $\left(b+\frac{a}{RTV}\right)$

D. $\left(b - \frac{a}{RTV}\right)$

Answer: B

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4. Which of the following has longest mean free path under identical conditions of temperature and pressure ?

A. H_2

B. N_2

C. O_2

D. CO_2

Answer: A

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5. Air contains N_2 and O_2 in the ratio of 4:1 by volume. The average conditions of temperature and pressure ?

A. 12.0

B. 14.4

C. 15.6

D. 28.8

Answer: B

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6. The critical temperature and reduced temperature of a gas are 150 K and 3 K respectively. What is the temperature of the gas ?

A. 50 K

B. 147 K

C. 153 K

D. 450 K

Answer: D

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Ii Multiple Choice Questions

1. In the equation $PV = RT$, the value of R will not depend upon

A. the nature of the gas

B. the temperature of the gas

C. the pressure of the gas

D. units of measurement.

Answer: A,B,C,D

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2. Boyle's law may be expressed as

A. $(dP/dV)_T = K/V$

B. $(dP/dV)_T = -K/V^2$

C. $(dP/dV)_T = -K/V$

D. $V \propto \frac{1}{p}$.

Answer: B,D

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3. Which the following represents the molar volume of the gas correctly

A. 22.4 L at $0^\circ C$ and 1 atm pressure

B. 22.7 L at $0^\circ C$ and 1 bar pressure

C. 24.8 L at SATP conditions

D. 22.5 L at $25^\circ C$ and 1 bar pressure .

Answer: A,B,C

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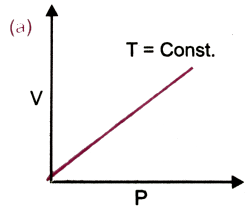
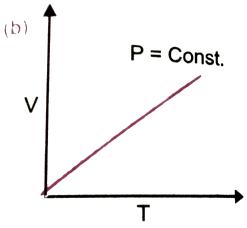
4. Which of the following plots are correct ?

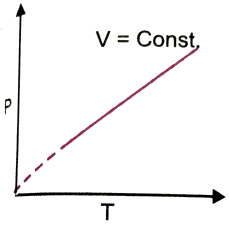
A.

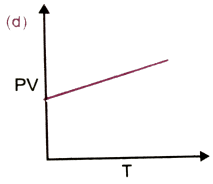


B.



C.



D. 

Answer: B,C,D

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5. Which of the following statements are correct ?

A. Both surface tension and viscosity decrease with increase of temperature.

B. There is no difference between normal boiling point and standard boiling point.

C. When a liquid boils, the vapours are formed only from the surface.

D. Glass is a highly viscous liquid.

Answer: A,D

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6. A gas described by van der Waals equation .

A. behaves similar to an ideal gas in the limit 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 identity of the gas but are independent of the pressure

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

Answer: A,B,C,D

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7. According to kinetic theory of gases:

A. collisions are always elastic

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

C. only a small number of molecules move in straight lines with constant velocities

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

Answer: A,B,C,D

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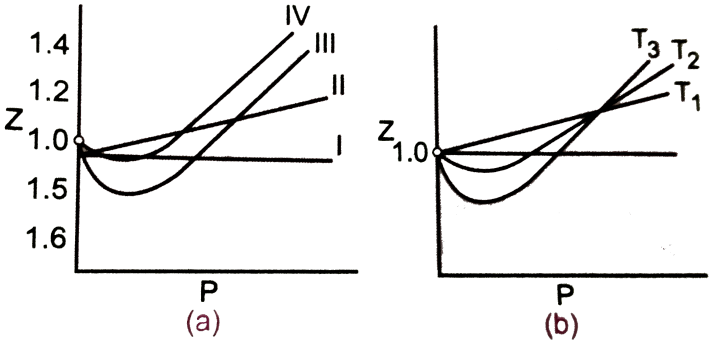
Iii Multiple Choice Questions

1. Real gases show deviations from ideal behaviour. Consequently, the observed molar volume of a gas is found to be different from theoretically calculated volume from ideal gas equation. The extent of deviation is measured in terms of compressibility factor, Z. It is found that gases which can be liquefied easily show largerdeviation. Further, it

is found that higher the speed of the gas molecules, less are the deviations. However, for evergy gas, there is a particular temperature above which they show ideal bahaviour over an appreciable range of pressure. This temperature is called Boyletemperature. The plots of compressibility factor versus pressure for a few gases and for the same gas at different temperatures and for the same gas at different temperatures are given below in Figs (a) and (b) respectively.The ideal gas equation has, therefore, been modified and for real gases, we apply vab der Waals equation, $\left(P+\frac{a}{V_2}\right)(V-b)=RT$ for 1 mole of the gas.



If V_0 is the observed volume of a gas and V_i is the ideal gas or volume, then the compressibility factor (Z) for the gas is

A. $\frac{V_\circ}{V_i}$

B. $\frac{V_i}{V_\circ}$

C. $V_\circ . V_i$

D. $V_\circ - V_i$

Answer: A,B,C,D

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2. Real gases show deviations from ideal behaviour. Consequently, the observed molar volume of a gas is found to be different from theoretically calculated volume from ideal gas equation. The extent of deviation is measured in

terms of compressibility factor, Z. It is found that gases which can be liquefied easily show largerdeviation. Further, it is found that higher the speed of the gas molecules, less are the deviations. However, for evergy gas, there is a particular temperature above which they show ideal bahaviour over an appreciable range of pressure. This temperature is called Boyletemperature. The plots of compressibility factor versus pressure for a few gases and for the same gas at different temperatures and for the same gas at different temperatures are given below in Figs (a) and (b) respectively.The ideal gas equation has, therefore, been modified and for real gases, we apply vab der Waals

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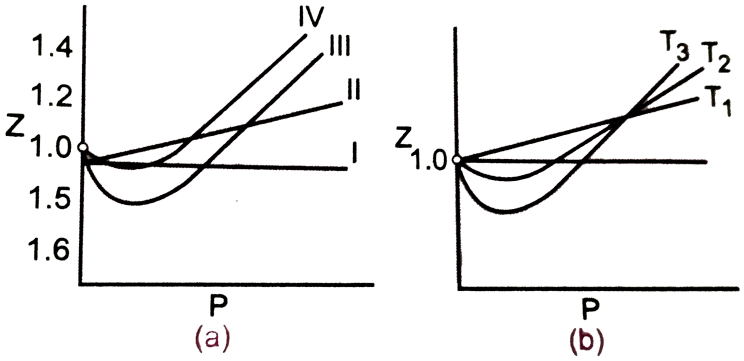

A. I

B. II

C. III

D. IV

Answer: B

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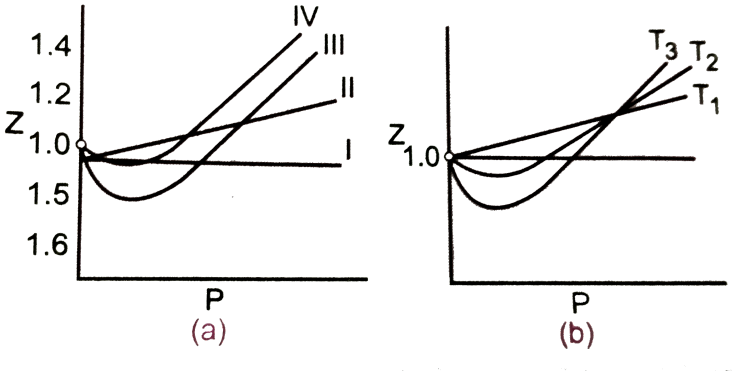

A. $T_1 > T_2 > T_3$

B. $T_3 > T_2 > T_1$

C. $T_2 > T_1 > T_3$

D. $T_2 > T_3 > T_1$

Answer: A

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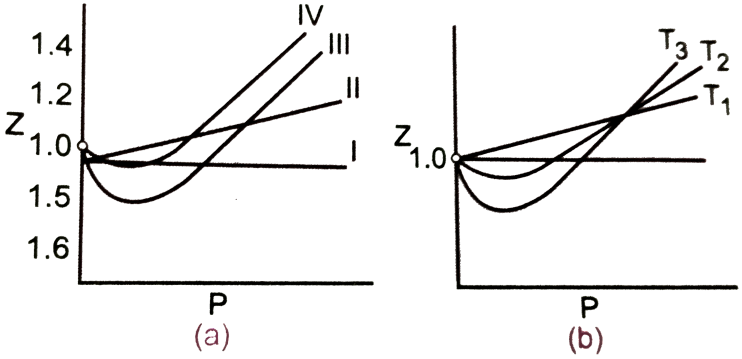
4. Real gases show deviations from ideal behaviour. Consequently, the observed molar volume of a gas is found to be different from theoretically calculated volume from ideal gas equation. The extent of deviation is measured in terms of compressibility factor, Z. It is found that gases which can be liquefied easily show largerdeviation. Further, it is found that higher the speed of the gas molecules, less are the deviations. However, for evergy gas, there is a particular temperature above which they show ideal bahaviour over an appreciable range of pressure. This temperature is called Boyletemperature. The plots of compressibility factor versus pressure for a few gases and for the same gas at different temperatures and for the same gas at different temperatures are given below in Figs (a) and (b) respectively.The ideal gas equation has, therefore, been modified and for real gases, we apply vab der Waals

equation, $\left(P+\frac{a}{V_2}\right)(V-b)=RT$ for 1 mole of the gas.



For 1 mole of gas II, the van der Waals equation reduces to the form

A. $\left(P-\frac{a}{V}\right)(V+b)=RT$

B. $\left(P+\frac{a}{V_2}\right)(V)=RT$

C. P(V-b)=RT

D. PV=RT

Answer: C

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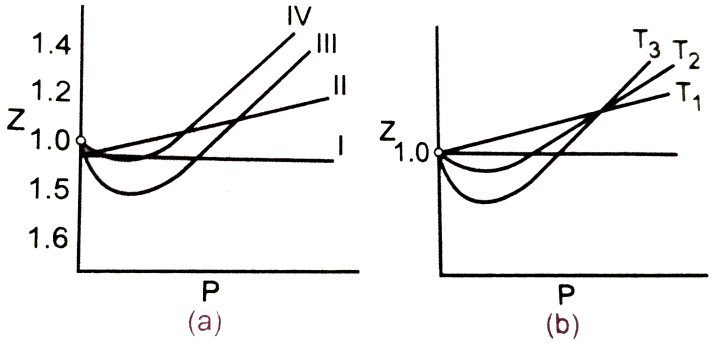
5. Real gases show deviations from ideal behaviour. Consequently, the observed molar volume of a gas is found to be different from theoretically calculated volume from ideal gas equation. The extent of deviation is measured in terms of compressibility factor, Z. It is found that gases which can be liquefied easily show largerdeviation. Further, it is found that higher the speed of the gas molecules, less are the deviations. However, for evergy gas, there is a particular temperature above which they show ideal bahaviour over an appreciable range of pressure. This temperature is called Boyletemperature. The plots of compressibility factor versus pressure for a few gases and for the same gas at different temperatures and for the same gas at different temperatures are given below in Figs (a) and (b) respectively.The ideal gas equation has, therefore, been

modified and for real gases, we apply vab der Waals equation, $\left(P+\frac{a}{V_2}\right)(V-b)=RT$ for 1 mole of the gas.



The gas which can be liquefied most easily is

A. I

B. II

C. III

D. IV

Answer: C

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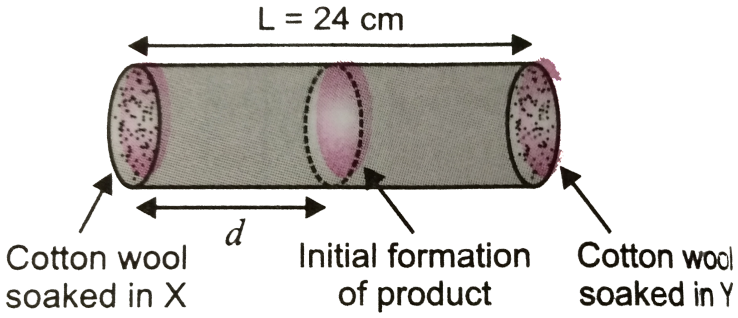
6. (JEE Adavanced 2014)

X and Y are two volatile liquids with molecular weights 10 g mol^{-1} and 40 g mol^{1} respectively. Two cotton plugs, one soaked in X and the other soaked in Y, are simultaneously placed at the ends of a tube with length L=24 cn as shown in the figure. The tube is filled with an inert gas at 1 atmosphere pressure and a temperature of 300 K. Vapours of X and Y react to form a product which is first observed at a distance of 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 the two vapours.



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

A. 8

B. 12

C. 16

D. 20

Answer: C

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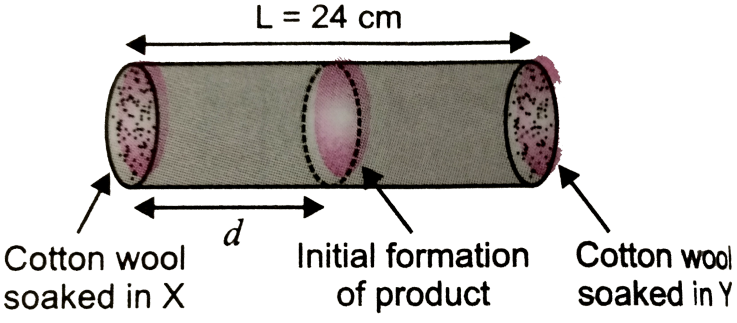
7. (JEE Adavanced 2014)

X and Y are two volatile liquids with molecular weights 10 g mol^{-1} and 40 g mol^{1} respectively. Two cotton plugs, one soaked in X and the other soaked in Y, are simultaneously placed at the ends of a tube with length L=24 cn as shown in the figure. The tube is filled with an inert gas at 1 atmosphere pressure and a temperature of 300 K. Vapours of X and Y react to form a product which is first observed at a distance of 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 the 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. large mean free path of X as compared to the of Y

B. large mean free path of Y as compared to the 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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Iv Matching Type Questions

1. Match the entries of column I with appropriate entries of column II and choose the correct option out of the four options (a),(b),(c) (d) given at the end of each question.

	Column I (*Gases X and Y taken for diffusion*)	Column II (*Ratio of times taken*)
(A)	X = 100 ml of H_2 at 1 bar, 25°C Y = 200 ml of O_2 at 1 bar 25°C	(*p*) 1 : 1·225
(B)	X = 100 ml of O_2 at 1 bar, 25°C Y = 200 ml of O_3 at 2 bar, 25°C	(*q*) 1 : 0·7
(C)	X = 100 ml of SO_2 at 1 bar, 25°C Y = 100 ml of O_2 at 1 bar, 25°C	(*r*) 1 : 1·36
(D)	X = HCl gas to travel 100 cm length in a tube Y = NH_3 gas to travel 200 cm length using the same tube (P, V, T = same in both cases)	(*s*) 1 : 8

A. A-s,B-p, C-q, D-r

B. A-s,B-q, C-p, D-r

C. A-q,B-s, C-r, D-p

D. A-p,B-r, C-q, D-s

Answer: A

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V Matrix Match Type Questions

1. Match the entries of column I with appropriate entries of column II. Each entry in column I may have one or more than one correct option from column II. If the correct matches are A-p, s, B-r , C-p, q , D-s, then the correctly bubbled 4xx4 matrix should be as shown :

Column I		Column II	
(A)	Rate of diffusion of a gas	(p)	$\propto$ P (P = pressure)
(B)	Root mean square velocity	(q)	$\propto 1/\sqrt{d}$ (d = density)
(C)	Average kinetic energy of a gas	(r)	$\propto \sqrt{T}$
(D)	Vapour pressure of a liquid	(s)	$\propto T$

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2. Match the entries of column I with appropriate entries of column II. Each entry in column I may have one or more than

one correct option from column II. If the correct matches are A-p, s, B-r , C-p, q , D-s, then the correctly bubbled 4xx4 matrix should be as shown :

	Column I		Column II
(A)	Root mean square speed	(p)	$\propto \sqrt{T}$
(B)	Average speed	(q)	$\propto \sqrt{\frac{1}{M}}$
(C)	Most probable speed	(r)	$\propto \sqrt{\frac{1}{d}}$
(D)	Kinetic energy per mole	(s)	$\propto T$

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Vi Integer Trpe Questions

1. Match 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 = 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 large molar volume	(s)	P (V – nb) = nRT

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2. A gas taken in a closed vessel is heated from $27^{\circ}C$ to $627^{\circ}C$. The pressure of the gas will become ..... times the original pressure

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3. At the same pressure, the rate of diffusion of a gas at $927^{\circ}C$ will be ..... Times that at $27^{\circ}C$.

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4. The rate of diffusion of a at 8 atmospheric pressure will be ..... Times that at 2 atmospheric pressure, temperature remaining constant

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5. If pressure of a gas is quadrupled and the temperature in degrees kelvin is doubled, the density of the will become ..... Times

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6. The temperature of the gas is raised from $27^\circ C$ to $927^\circ C$, the root mean square velocity is

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7. A highly viscous liquid was heated from $10^{\circ}C$ to $14^{\circ}C$. The per cent decrease in viscosity will be about

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8. At $400K$, the root mean square (rms) speed of a gas X (molecular weight = 40) is equal to the most probable speed of gas Y at 60 K. The molecular weight of the gas Y is.

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9. 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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10. 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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Vii Numerical Value Type Questions

1. A closed tank has two compartments A and B, both filled with oxygen (assumed to be ideal gas). The partition separating the two compartments is fixed and is a perfect heat insulator. If the old partition is replaced by a new partition which can slide and conduct heat but does not allow the gas to leak across (Figure 2), the volume (in m^3) of the compartment A after the system attains equilibrium is .....

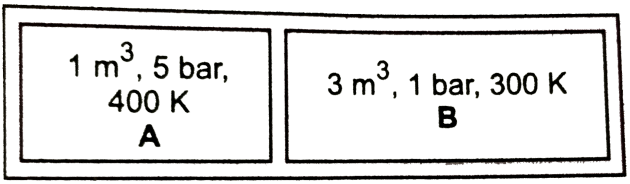

Figure 1

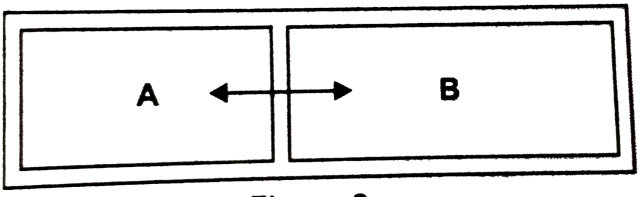

Figure 2

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Viii Assertion Reason Type Questions Type I

1. Statement-1. At zero degree Kelvin, the volume occupied by a gas is negligible.

Statement-2. All molecullar motion ceases at 0 K.

A. Statement-1 is correct, Statement-2 is correct , Statement-2 is the correct explanation for Statement-1.

B. Statement-1 is correct, Statement-2 is correct , Statement-2 is not a correct explanation of Statement-1.

C. Statement-1 is correct, Statement-2 is incorrect.

D. Statement-1 is incorrect, Statement-2 is correct.

Answer: C

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

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

A. Statement-1 is correct, Statement-2 is correct , Statement-2 is the correct explanation for Statement-1.

B. Statement-1 is correct, Statement-2 is correct , Statement-2 is not a correct explanation of Statement-1.

C. Statement-1 is correct, Statement-2 is incorrect.

D. Statement-1 is incorrect, Statement-2 is correct.

Answer: A

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3. Statement-1. Compressibility factor of non-ideal gases is always less than1.

Statement-2. Non-ideal gases exert less pressure than expected for ideal gas.

A. Statement-1 is correct, Statement-2 is correct , Statement-2 is the correct explanation for Statement-1.

B. Statement-1 is correct, Statement-2 is correct , Statement-2 is not a correct explanation of Statement-1.

C. Statement-1 is correct, Statement-2 is incorrect.

D. Statement-1 is incorrect, Statement-2 is correct.

Answer: D

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4. Statement-1. Vapour pressure of liquid ammonia is higher than that of water.

Statement-2. Molar mass of ammonia is less than that fo water.

A. Statement-1 is correct, Statement-2 is correct , Statement-2 is the correct explanation for Statement-1.

B. Statement-1 is correct, Statement-2 is correct , Statement-2 is not a correct explanation of Statement-1.

C. Statement-1 is correct, Statement-2 is incorrect.

D. Statement-1 is incorrect, Statement-2 is correct.

Answer: B

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5. Statement-1. Less is the critical temperature of a gas, more easily it can be liquefied.

Statement-2. Critical temperature is the temperature above which a gas cannot be liquiefied applying any amount of pressure.

A. Statement-1 is correct, Statement-2 is correct , Statement-2 is the correct explanation for Statement-1.

B. Statement-1 is correct, Statement-2 is correct , Statement-2 is not a correct explanation of Statement-1.

C. Statement-1 is correct, Statement-2 is incorrect.

D. Statement-1 is incorrect, Statement-2 is correct.

Answer: D

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6. Statement-1. The value of van der Waals constant 'a' is higher for ammonia than for nitrogen.

Statement-2 Intermoleucular hydrogen bonding is percent in ammonia.

A. Statement-1 is correct, Statement-2 is correct , Statement-2 is the correct explanation for Statement-1.

B. Statement-1 is correct, Statement-2 is correct , Statement-2 is not a correct explanation of Statement-1.

C. Statement-1 is correct, Statement-2 is incorrect.

D. Statement-1 is incorrect, Statement-2 is correct.

Answer: A

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Viii Assertion Reason Type Questions Type Ii

1. Assertion. London forces of are the attractive forces existing among non-polar molecules or noble gases.

Reason. London forces are the attractive forces which operate at all distances between the molecules atoms.

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2. Assertion. For a certain fixed amount of gas, the product PV is always constant.

Reason. Real gases have higher pressure and lower volume than ideal gases and hence product PV is constant.

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3. Assertion: Effusion rate of oxygen is smaller than nitrogen.

Reason: Molecular size of nitrogen is smaller than oxygen.

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4. Assertion. Different gases at the same conditions of temperature and pressure have same root mean velocity.

Reason. Root mean square velocity lies between average velocity and most probable velocity.

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5. Assertion. At same temperature, most probable speed of N_2 is greater than that of Cl_2.

Reason. At the same temperature, fraction of N_2 molecules possessing the most probable slope speed is greater than that of Cl_2 molecules.

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6. Assertion: Compressibility factor for hydrogen varies with pressure with positive slope at all pressures.

Reason: Even at low pressures, repulsive forces dominate hydrogen gas.

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7. A : At high pressure , the compressibility factor Z is $\left(1+\frac{pb}{RT}\right)$.

R : At high pressure van der Wall's equation is modified as $p(V - b) = RT`$.

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8. Assertion. The value of van der Waals constant 'a' for ammonia is larger that that of nitrogen gas.

Reason. Molecular weight of ammonia is smaller that that of nitrogen gas.

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9. Assertion : At critical temperature, the densities of the gaseous and liquid phase become equal.

Reason : At critical point, surface of separation between the lqiuid phase and the gaseous phase disappears.

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10. Assertion. Viscosity of liquid decreases on increasing the temperature.

Reason. Evaporation of a liquid increases with rise in temperature.

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11. Assertion. Menscus of a liquid disappears at critical temperature.

Reason. Density of a liquid and its gaseous phase become equal at the critical temperature.

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12. Assertion. CO_2 above $31^\circ C$ and 600 pressure is used for removing caffeine from coffee beans.

Reason. CO_2 is gaseous in nature.

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