CHEMISTRY

BOOKS - MODERN PUBLISHERS CHEMISTRY (HINGLISH)

STATES OF MATTER : GASES AND LIQUIDS

Solved Examples

1. A gas occupies 200mL at a pressure of 0.820 bar at $20^\circ C$. How much volume will it occupy when it is subjected to exlernal pressure of 1.025 bar al the same temperature?

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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. A gas occupies a volume of 250 mL at 745 mm Hg and $25^{\circ} C$. What additional pressure is required to reduce the gas volume to 200 mL at the same temperature?

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4. A ballon is filled with hydrogen at room temperature. It will burst if pressure exceeds 0.2bar. If at I bar pressure, the gas occupies $2.27L$ volume, up to what volume can the balloon be expanded?

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5. A sample of gas occupies 1.50 L at $25^{\circ} C$. If the temperature is raised to $60^{\circ} C$, what is the new volume of the gas if pressure remains constant?

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6. A sample of helium has volume of 520 mL at $100^{\circ}C$. Calculate the temperature at which the volume will become 260 mL. Assume that pressure is constant.

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

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8. On a ship sailing in pacific ocean where temp. is 23.4° C A balloon is filled with 2L air, what will be the volume of balloon where the ship reaches Indian ocean where temp is 26.1° C :-

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9. What is the increase in volume when the temperature of 800 mL of air increases from $27^\circ C$ to $47^\circ C$ under constant pressure of 1 bar?

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10. 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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11. A chamber of constant volume contains hydrogen gas. When the chamber is immersed in a bath of melting ice $(0^\circ C)$ the pressure of the gas is 800 torr. What pressure will be indicated when the chamber is brought to $100^\circ C$?

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12. A sample of nitrogen occupies a volume of 1.0 L at a pressure of 0.5 bar at $40^\circ C$. Calculate the pressure if the gas is compressed to $0.225\ \text{mL}$ at $-6^\circ C$.

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13. 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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14. Calculate the moles of hydrogen (H_2) present in a 500 mL sample of hydrogen gas at a pressure of 1 bar and $27^\circ C$.

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15. Calculate the volume occupied by 4.045×10^{23} molecules of oxygen at $27^{\circ} C$ and having a pressure of 0.935 bar.

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16. A discharge tube of 2L capacity containing hydrogen gas was evacuated till the pressure inside is $1 \times 10^{-5} atm$. If the tube is maintained at a temperature of $27^{\circ} C$, calculate the number of hydrogen molecules still present in the tube.

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17. Calculate the mass of 120 mL of N_2 at $150^{\circ} C$ and $1 \times 10^5 Pa$ pressure.

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18. Calculate the volume occupied by 8.8 g of CO_2 at $31.1^\circ C$ and 1 bar pressure. R= 0.083 bar L $K^{-1}mol^{-1}$.

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19. Calculate the volume occupied by 2 moles of an ideal gas at $2.5 \times 10^5 Nm^{-2}$ pressure and 300K temperature.

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

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21. 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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22. $2.9g$ 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 ? .

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23. The drain cleaner Drainex contains small bits of aluminium which react with caustic soda to produce hydrogen What volume of hydrogen at $20^\circ C$ aand one bar will be released when $0.15g$ of aluminium reacts ? .

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24. The density of a gas at $27^\circ C$ and 1 bar pressure is $2.56\,\mathrm{g\,L^{-1}}$. Calculate the molar mass.

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25. The mass of 525 ml of a gaseous compound at $28^{\circ}C$ and 0.970 bar pressure was found to be 0.900 g. Calculate the molar mass of the compound.

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26. Density of a gas is found to be $5.46g/dm^3$ at $27^{\circ}C$ and 2 bar presure. What will be its density at STP?

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27. 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 ? .

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28. Calculate the density of ammonia (NH_3) at $30^\circ C$ and 5 bar pressure.

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29. 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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30. 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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31. A neon-dioxygen mixture contains 70.6 g dioxygen and 167.5 g neon. If pressure of the mixture of gases in the cylinder is 25 bar. What is the partial pressure of dioxygen and neon in the mixture ?

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32. A gaseous mixture containing $50g$ of nitrogen and $10g$ of oxygen were enclosed in a vessel of $10L$ capacity at $27^{\circ}C$. Calculate

(a) the number of moles of each gas.

(b) the partial pressure of each gas.

(c) the total pressure of gaseous mixture.

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33. 135 mL of a gas is collected over water at $25^{\circ}C$ and 0.993 bar. If the gas weighs 0.160 g and the aqueous tension at $25^{\circ}C$ is 0.0317bar, calculate the molar mass of the gas.

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34. An unknown gas diffuses four times as quickly as oxygen. Calculate the molar mass of the gas.

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35. The relative densities of oxygen and carbon dioxide are 16 and 22 ,respectively. If $25cm^3$ of carbon dioxide effuses out in $75s$, What volume of oxygen will effuse out in $96s$ under similar condition?

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36. For 10 minutes each at $27^\circ C$ from two identical holes nitrogen and an unknow gas are leaked into a common vessel of 3 litre capacity The resulting pressure is 4.18 bar and the mixture contains 0.4 mole of nitrogen What is the molar mass of the unknown gas ? .

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37. A $4:1$ molar mixture of He and CH_4 is contained in a vessel at 20^- 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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38. 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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39. A straight glass tube has two inlets x and y at two ends. The length of the tube is $200cm$. HCl gas through inlet x and NH_3 gas through inlet y are allowed to enter the tube at the same time. White flames first appear at a point P inside the tube. Find the distance of P from x.

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40. Calculate the kinetic energy of 2 g of oxygen at $-23^\circ C$.

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

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42. A gas consists of 4 molecules with a velocity of $5ms^{-1}$, 10 molecules with a velocity of $3ms^{-1}$ and 6 molecules with a velocity of $6ms^{-1}$. Calculate their average velocity, root mean square velocity and most probable velocity.

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43. Calculate the root mean square speed of methane molecules at $27^{\circ}C$.

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44. Nitrogen molecule (N_2) has radius of about 0.2 nm. Assuming that nitrogen molecule is spherical in shape, calcualte

(a) volume of a single molecule of N_2.

(b) the percentage of empty space in one mole of N_2 gas at S.T.P.

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

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46. One mole of CO_2 occpuies 1.5 L at $25^{\circ}C$. Calculate the pressure exerted by the gas using

(i) ideal gas equation

van der Waals gas equation with $a = 3.6L^2$ bar mol^{-2} and $b = 0.04\,\text{L}\,\text{mol}^{-1}$

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47. 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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48. For oxygen gas, has van der Waals constant b is $0.318\,\mathrm{L\,mol^{-1}}$. Calculate the diameter of oxygen molecule.

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49. A vessel of 25 L capacity contains 10 mol of steam under 50 bar pressure. Calculate the temperature of steam using van der Waals equation if for water : $a = 5.46\ \mathrm{bar\ L^2mol^{-2}}$ and $b = 0.031\ \mathrm{L\,mol^{-1}}$.

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50. Two moles of a real gas confined in a 5 L flask exerts a pressure 9.1 atm at a temperature of $27^{\circ} C$. Calculate the value of 'a' given the value of b is $0.052 \mathrm{~L~mol}^{-1}$.

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51. 1 mole of sulphur dioxide occupies a volume of 350 ml at $27^{\circ} C$ and 5×10^{6} Pa pressure. Calculate the compressibility factor of the gas. Is it less or more compressible than an ideal gas ?

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52. The critical temperature and pressure for NO gas are 177 K and 64.5 atm respectively. Calculate van der Waals constants 'a' and 'b' for this gas.

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53. Calculate the critical temperature of a Van der Waals gas for which p_c is 100 atm and b is $0.050\ \mathrm{dm}^3\ \ \mathrm{mol}^{-1}$.

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54. Critical temperature of ammonia and carbon dioxide are 405.5 K and 304.10 K respectively. Which of these gases will liquefy first when you start cooling from 500 K to their critical temperature?

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55. The melting point is a rough measure of the attractive force in solids. Arrange the following solids in the order of increasing strength of attractive force.

	m.p. (K)
Naphthalene	353
Sodium fluoride	1272
Water (ice)	273
Phosphorus	317
Zinc idoide	719

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56. Name the liquid with higher vapour pressure in the following pairs :

(a) Alcohol, glycerine , (b) Petrol, kerosene, (c) mercury, water.

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Practice Problems

1. $5L$ of nitrogen measured at $750mm$ have to be compressed into an iron cylinder of $1L$ capacity. If temperature is kept constant, calculate the pressure in atmospheres required to do so.

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2. A weather ballon has a volume of $175dm^3$ when filled with hydrogen gas at a pressure of $1 \cdot 0$ bar. Caculate the volume of the bolloon when it

rises to a height where the atmospheric pressure is $0 \cdot 8$ bar. Assume that temperature is constant.

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3. A sample of gas at $20^{\circ} C$ occupies a volume of 2 L at a pressure of $0.867 \times 10^{5} Pa$. Calculate its volume at 100 kPa atmospheric pressure.

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4. At a constant temperature, a gas occupies a volume of $200 mL$ at a pressure of $0.720 \mathrm{bar}$. It is subjected to an external pressure of $0.900 \mathrm{bar}$. What is the resulting volume of the gas?

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5. A bulb of unknown volume V contains a gas at 1 atm pressure. This bulb was connected to another evacuated bulb of volume 0.5 L through a stop

cock. When the stop cock was opened, the pressure at each bulb becomes $7.58 \times 10^4 \mathrm{Pa\,mm}$ while the temperature remained constant. Calculate V in litres.

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6. A given mass of gas occupies $4.5 dm^3$ at 1.2 bar pressure. Calculate the change in volume of the gas at the same temperature if pressure of the gas is changed to 1.8 bar.

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7. 325 mg of gas has a volume of $0.5 dm^3$ at $-10^\circ C$ and 1 bar pressure. What will be the volume of the gas at $10^\circ C$ at the same pressure?

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8. It is desired to increase the volume of $800 cm^3$ of a gas by 20% keeping the pressure constant. To what temperature should the gas be heated, if the initial temperature is $22^\circ C$?

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9. At what temperature on Celsius scale will the volume of a given mass of a gas at $0^\circ C$ become half of its volume at constant pressure?

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10. A sample of air occupies 10 L at $127^\circ C$ and 1 atm pressure. What volume of air will be expelled when it is cooled to $-23^\circ C$ at the same pressure?

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11. 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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12. A sample of oxygen gas occupies 431 mL at standard temperature and pressure. Calculate the volume when the temperature is $35^{\circ}C$ and pressure is 1.05 bar.

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13. Ten grams of oxygen are introduced into an evacuated vessel of $5dm^3$ capacity maintained at $26^{\circ}C$. Calculate the pressure $\left(R = 0.083 \text{ bar } \text{dm}^3\text{mol}^{-1}K^{-1}\right)$

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14. The density of liquid CO_2 at room temperautre is $0.8\,\mathrm{g\,cm^{-3}}$. How large a cartridge of liquid CO_2 must be provided to inflate a life jacket of 4 litres capacity at S.T.P.?

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15. 150 mL of a gas at S.T.P. were taken to $20^\circ C$ and 0.96 bar pressure. What is the change in volume of the gas?

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16. Calculate the number of molecules in a sample of an ideal gas whose volume is 0.45 L at $67^\circ C$ and 0.76 bar pressure.

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17. The density of phosphine gas is $1.27\,\mathrm{g\,dm^{-3}}$ at $50^{\circ}C$ and $0.987 \times 10^{5} Pa$. Calculate its molar mass.

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18. The density of oxygen is $1.43 gL^{-1}$ at STP. Determine the density of oxygen at $17^{\circ}C$ and 800 torr.

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19. 34.05 mL of phosphorus vapour weigh 0.0625 g at $546^{\circ}C$ and 1.0 bar pressure. What is the molecular mass of phosphorus? How many atoms are there in one molecule of phosphorus?

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20. A closed tank is first evacuated and then connected to a 50 L cylinder containing compressed nitrogen gas. The gas pressure in the cylinder originally at 20.5 bar falls to 11.2 bar after it is connected to the evacuated tank. Calculate the volume of the tank.

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21. 18 g mixture of hellium and argon occupied 30 L at 1 atm pressure and $27^{\circ} C$. Calculate the percentage of these gases in the mixture.

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22. 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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23. 2.9 g of a gas at $95^\circ C$ occupied the samme volume as 0.184 g of dhydrogen at $17^\circ C$, at the same pressure, what is the molar mass of the gas?

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24. $3.7gm$ of gas at $25^\circ C$ occupied the same volume as $0.184gm$ of hydrogen at $17^\circ C$ and at the same pressure. What is the molecular mass of the gas ?

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25. $20\ \%\ N_2O_4$ molecules are dissociated in a sample of gas at $27^\circ C$ and 760 torr. Calculate the density of the equilibrium mixture.

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26. 500 mL of nitrogen at 0.936 bar pressure and 1000 mL oxygen at 0.80 bar pressure are put together in a 2 L flask. IF temperature is kept constant, calculate the final pressure of the mixture.

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27. 400 mL of oxygen are collected over water at N.T.P. $(\text{Aqueous tension at } 25^\circ C = 0.0318 \text{ atm})$.calculate the volume of oxygen at 1 atm and 0 degree celcius.

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28. A $2.5L$ flask contains $0.25mol$ each of sulphur dioxide and nitrogen gas at $27^\circ C$. Calculate the partial pressure exerted by each gas and also the total pressure.

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29. A 5.0 L flask contains 19.5 g of SO_3 and 1.0 g of He gas at $20^\circ C$. Calculate the partial pressures exerted by SO_3 and He and the total pressure of the gaseous mixture.

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30. 1.00 mol of N_2 and 3.00 mol of H_2 are present in a container of volume $10.0 dm^3$ at 298 K. What is the total pressure of the mixture?

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

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32. At sea level, the composition of dry air is approximately $N_2 = 75.5\,\%$, $O_2 = 23.2\,\%$, and $Ar = 1.3\,\%$ by mass. If the total pressure at sea level

is 1bar, what is the partial pressure of each component?

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33. A 1.0 L flask contains 2.0 g of N_2, $0.4gH_2$ and 9.0 of O_2 at $27^\circ C$. What is the pressure in the flask?

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34. 0.6 g of a gas at $15^\circ C$ and 745 mm Hg occupies $200cm^3$. It occupies $182.6cm^3$ in dry state at N.T.P. Calculate the aqueous tension at $15^\circ C$.

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35. A mixture of hydrogen and oxygen in one bar pressure contains $20\,\%$ by weight of hydrogen Calculate the partial pressure of hydrogen.

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

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37. The volume of a gas X and chlorine diffusing during the same taime are 35 ml and 29 ml respectively. If the molar mass of chlorine is 71, calculate the molar mass of gas(X).

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38. A certain gas, G takes four times as long to effuse out as H_2. What is its molecular mass?

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

molar mass of B .

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40. Which of the two gases, ammonia and hydrogen chloride, will diffuse faster and by what factor?

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41. $180cm^3$ of a hydrocarbon diffuses in 15 min, while under the same conditions, $120cm^3$ of sulphur dioxide diffuse in 20 min. If the molecular mass of SO_2 is 64, what is the molecular formula of the hydrocarbon?

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42. A gaseous mixture of O_2 and an unknown gas 'X' containing 20 mole $\%$ of X diffused through a small hole in 245 seconds while O_2 takes 220

seconds to diffuse through the same hole under similar conditions. Calculate the molecular mass of X.

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43. Calculate the molecular weight of a gas X which diffuses four times as fast as another gas Y, which in turn diffuses twice as fast as another Z. Molecular weight of the gas Z is 128.

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44. Calculate the kinetic energy of 2 moles of an ideal gas at $27^{\circ} C$.

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45. What is the average kinetic energy of a gas molecule at $27^{\circ} C$?

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46. Calculate the temperature at which kinetic energy of 0.5 mole of Cl_2 gas is 2.182 kJ.

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47. At what temperature, the root-mean-square velocity of SO_2 will be the same as that of CH_4 at $27^\circ C$?

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48. At what temperature will the root mean square velocity of methane become double of its value at N.T.P.?

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49. Calculate the r.m.s. velocity of argon (atomic mass = 40) at N.T.P.

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50. Two moles of ammonia were found to occupy a volume of 5 L at $27^{\circ} C$. Calculate the pressure using van der Waals equation $\left(a = 4.17 \text{ bar } \text{L}^2\text{mol}^{-2}, b = 0.0371 \text{ L mol}^{-1}\right)$.

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51. Compare the temperature of 3 molof SO_2 at 15 bar occupying a volume of 10 L obtained by the ideal gas equation and van der Waals equation $\left(a = 6.7 \text{ bar } \text{L}^2\text{mol}^{-2}, b = 0.0564 \text{ L mol}^{-1}\right)$

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52. Whichof the following statements are correct ?

(a) With rise in temperature, surface tension of a liquid increases.

(b) The rise of a liquid in a capillary is due to the phenomenon of diffusion.

(c) The boiling point of water is lower is Shimla than in Jalandhar.

(d) The viscosity of a liquid is generally more than that of a gas.

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53. The heats of vaporization of H_2O, C_2H_5OH and CS_2 are $40.6\ \text{kJ}mol^{-1}$, $38.6kJmol^{-1}$ and $26.8kJmol^{-1}$ respectively. The strength of intermolecular forces in these liquids is in the order of _____.

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54. Which one, in each of the following pairs is more viscous?

(a) coconut oil, castor oil

(b) glycerine, kerosene

(c) soft drink, aerated water

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Advanced Level Problems

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

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2. 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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3. A spherical balloon of 21 cm diameter is to be filled up with hydrogen at $1atm, 273K$ from a cylinder containing the gas at $20atm$ and $27^\circ C$. If

the cylinder can hold 2.82 litre of water, calculate the number of balloons that can be filled up completely.

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4. A evacuated bulb of unknown volume is filled with H_2 gas at room temperature $(30^\circ C)$. The pressure of the gas in the bulb is 750 mm Hg. A portion of the gas is transferred to a different flask and found to occupy a volume of 50.0 mL at 1 atm pressure and at the same temperature. the pressure of the H_2 gas remaining in the original bulb drops to 600 mm Hg. What is the volume of the bulb assuming H_2 gas is an ideal gas ?

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5. A $10L$ flask at $298K$ contains a gaseous mixture of CO and CO_2 at a total pressure of 2.0bar if 0.20 mole of CO is present, find its partial pressure and also that of CO_2.

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6. The circulation of blood in the human body supplied oxygen and removes carbon dioxide. The concentration of oxygen and carbon dioxide is variable but on an average 100 ml of blood contains 0.02 g of oxygen and 0.08 g of carbon dioxide. Calculate the volume of oxygen and carbon dioxide at 1 atm and body temperature $(37^\circ C)$ assuming that there are 10 litres of blood in the human body.

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7. 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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8. An L.P.G. cylinder weight $14.8kg$ when empty. When full, it weighs $29kg$ and shows a pressure of $2.5atm$. In the course of use at $27^\circ C$, the weight

of the full cylinder reduced to $23.2kg$. Find out the volume of $n-$ butane in cubic metres used up at $27^{\circ}C$ and $1atm$. [Mol. mass of butane = 58]

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9. At $26.7^{\circ}C$, the vapour density of a gaseous mixture containing NO_2 and N_2O_4 is 38.31. calculate the number of moles of NO_2 in 100g of that mixture.

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10. The pressure exerted by $12g$ of an ideal gas at temperature $t^{\circ}C$ in a vessel of volume V litre 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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11. Two flask A and B have equal volume. Flask A contains H_2 and is maintained at 300 K while flask B contains an equal mass of CH_4 gas and is maintained at 600 K.

(i) Which flask contains a greater number of molecules? How many times more?

(ii) In which flask is the pressure greater ? How many times greater ?

(iii) In which flask will the molecules moves faster ?

(iv) In which flask will the number of collisions with the wall greater?

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

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

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14. 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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Conceptual Questions 1

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

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2. Why mercuty is used in a barometer. Though it is costly? Why cannot we use water in place of mercuty.

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3. Why is it not possible to cool a gas to a temperature of absolute $(0K)$?

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4. What is molar volume of an ideal gas under N.T.P. conditions ?

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5. Arrange solid, liquid and gas in order of increasing energy?

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6. What is the ratio of average molecular kinetic energy of CO_2 to that to SO_2 at $27^\circ C$?

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7. Why dry air is heavier than moist air?

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8. At what temperature will oxygen molecules have the same K.E. as ozone molecules at $30^\circ C$?

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9. How is the mole fraction of a gaseous component related to its partial pressure and the total vapour pressure?

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

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

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

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13. A manometer is connected to a gas containing bulb. The level of mercury in open arm is 2.6 cm lower than that in the other arm of the

manometer. What is the pressure of the gas if the atmospheric pressure is 752 mm Hg?

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14. 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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15. At what temperature will both the Celsius and Fahrenheit scales read the same value?

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16. Calculate the height of a column of water equivalent to 1 atmosphere.

$\left(\text{density of Hg} \quad = 13.6 g cm^{-3}\right)$

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17. Is Dalton's law of partial pressures valid for a mixture of SO_2 and O_2?

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Conceptual Questions 2

1. The Van der Waals constants for two gases A and B are as follows :

Gas	$a\left(\text{atm L}^2\ \text{mol}^{-2}\right)$	$b\left(\text{L mol}^{-1}\right)$
A	1.63	0.0326
B	3,72	0.0521

Which of these

(i) is more easily liquefied?

(ii) has larger molecular size?

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2. What property of molecules of real gases is indicated by Van der Waals constant 'a'? (ii) has larger molecular size ?

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3. Which two postulates of the kinetic molecular theory are only approximations when applied to real gases ?

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4. What do you understand by 'triple point' of a substance?

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5. Urea has a sharp melting point but glass does not. Explain.

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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. Explain why water would completely fill a fine capillary tube which is open at both ends when one end is immersed in water.

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8. Why are falling liquid drops spherical?

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9. Why cooling is caused by evaporation?

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10. Out of NH_3 and N_2, which will have

(a) larger value of a

(b) larger value of b

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11. What would have happened to the pressure of a gas if the collisions of its molecules had not been elastic?

Watch Video Solution

12. Why are the gases helium and hydrogen not liquefied at room temperature by applying very high pressure ?

Watch Video Solution

13. Name the liquid with higher vapour pressure in the following pairs :

(a) Alcohol, glycerine , (b) Petrol, kerosene, (c) mercury, water.

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14. What is Boyle's temperature ?

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15. Name the intermolecular forces between

$(i) Cl_2$ and CBr_4 $(ii) SiH_4$ molecules (iii) He

(iv) HCl molecules in liquid HCl (v) He and a polar molecule (vi) Wa

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

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

Watch Video Solution

18. The SI unit of the coefficent of viscosity is

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

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20. For gases like H_2 and He which show only positive deviation from ideal behaviour, the compressibility factor is greater than 1.Is the statement true or false.

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Ncert File Ncert Textbook Exercises

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. The drain cleaner, Drainex contains small bits of aluminium which react with caustic soda to produce dihydrogen. What volume of dihydrogen at $20^{\circ}C$ and one bar will be released when 0.15 g of aluminium reacts?

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7. 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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8. 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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9. 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 ? .

Watch Video Solution

10. 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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11. 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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12. Calculate the temperature of 4.0 mol of a gas occupying d dm^3 at 3.32 bar. (R=0.083 bar $dm^3K^{-1}mol^{-1}$).

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

Watch Video Solution

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

Watch Video Solution

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

Watch Video Solution

16. 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 $dm^{-3}K^{-1}mo1^{-1}$) .

Watch Video Solution

17. Calculate the volume occupied by 8.8 g of CO_2 at $31.1^\circ C$ and 1 bar pressure. R= 0.083 bar L $K^{-1}mol^{-1}$.

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18. $2.9g$ 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 ? .

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

Watch Video Solution

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

Watch Video Solution

22. 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?

Watch Video Solution

23. Discuss in brief the significance of the van der Waal's connstants. Also write their units.

Watch Video Solution

Ncert File Ncert Exemplar Problems Multiple Choice Questions Type 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

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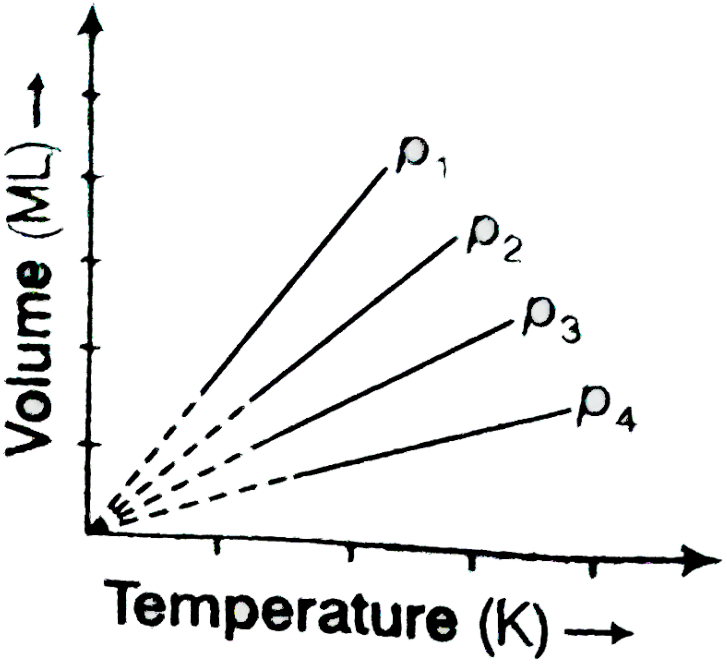
2. Which of the following property of water can be used to explain the spherical shape of rain droplets ?

Watch Video Solution

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 figure. 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:

Watch Video Solution

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

Watch Video Solution

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:

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6. What will be the molar volume of nitrogen and Helium at $273.15K$ and $1atm$?

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7. 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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8. 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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9. Value of universal gas constant (R) is same for all gases. What is its physical significance ?

Watch Video Solution

10. 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

11. 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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12. 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 ?

Watch Video Solution

13. 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 ?

Watch Video Solution

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

Watch Video Solution

15. 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.

Watch Video Solution

16. 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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17. 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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18. 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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19. 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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20. Name two phenomena that can be explained on the basis of surface tension.

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21. 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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22. 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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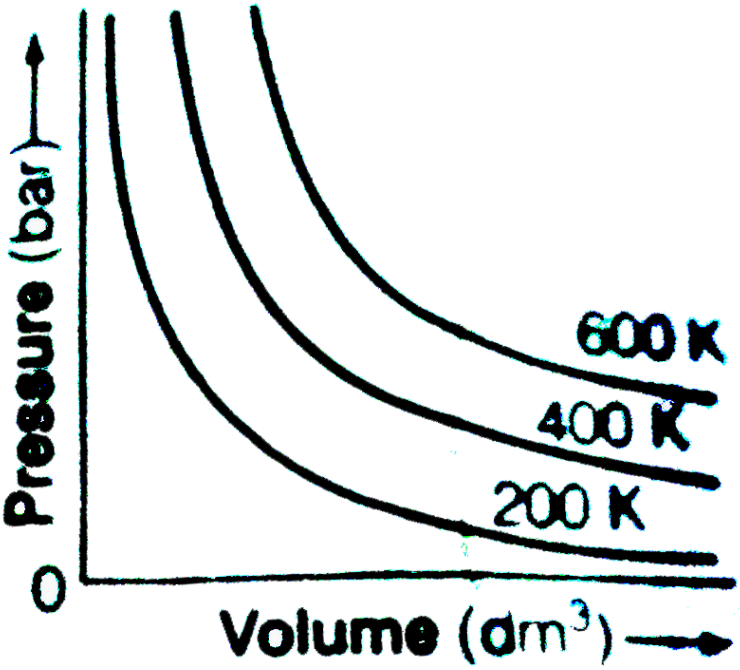
23. The variation of pressure with volume of the gas at different temperatures can be graphically represented as shown in figure. On the basis of this graph answer the following question.

(i) How will the volume of a 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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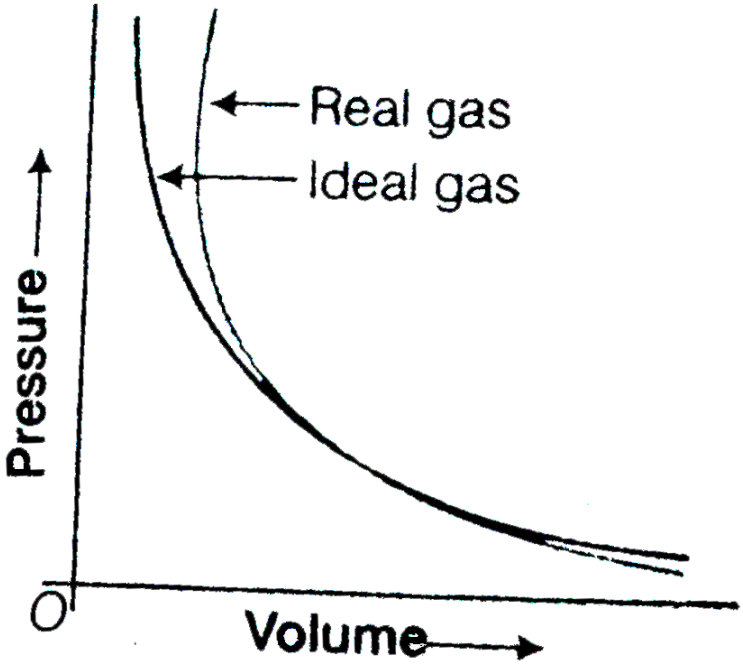
24. Pressure versus volume graph for real gas and are shown in figure. Answer the following question on the basis of this graph.



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

(ii) Interpret the behaviour of real 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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Ncert File Ncert Exemplar Problems Matching Type Question

1. Match the graphs between the following variables with their names :

Graphs	*Names*
(*i*) Pressure vs temperature graph at constant molar volume.	(*a*) Isotherms
(*ii*) Pressure vs volume graph at constant temperature.	(*b*) Consent temperature curve
(*iii*) Volume vs temperature graph at constant pressure.	(*c*) Isochores
	(*d*) Isobars

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2. Match the following gas laws with the equation representing them.

(*i*) Boyle's law	(*a*) $V \propto n$ at constant T and p
(*ii*) Charle's law	(*b*) $p_{Total} = p_1 + p_2 + p_3 + ... +$ at constant T,V
(*iii*) Dalton's law	(*c*) $\frac{pV}{T}$ = Constant
(*iv*) Avogadro law	(*d*) $V \propto T$ at constant n and p
	(*e*) $p \propto \frac{1}{V}$ at constant n and T

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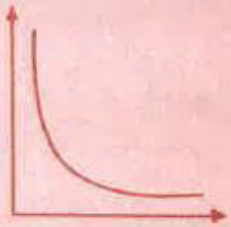
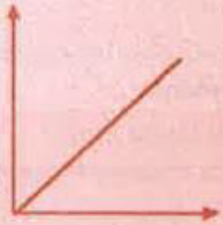
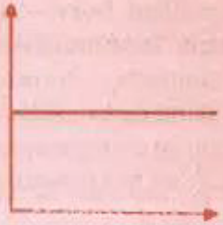
3. Match the following graphs of ideal gas with their coordinates :

Graphical representation	*x and y co-ordinates*
(*i*) 	(A) pV vs. V
(*ii*) 	(B) p vs. V
(*iii*) 	(C) p vs. $\frac{1}{V}$

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Ncert File Ncert Exemplar Problems 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 but 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 but 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 but 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 but 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 but 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 but 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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Ncert File Ncert Exemplar Problems Long Answer Questions

1. Isotherms of carbon dioxide at various temperature are represented in Fig.

Answer the following questions bases of this figure.

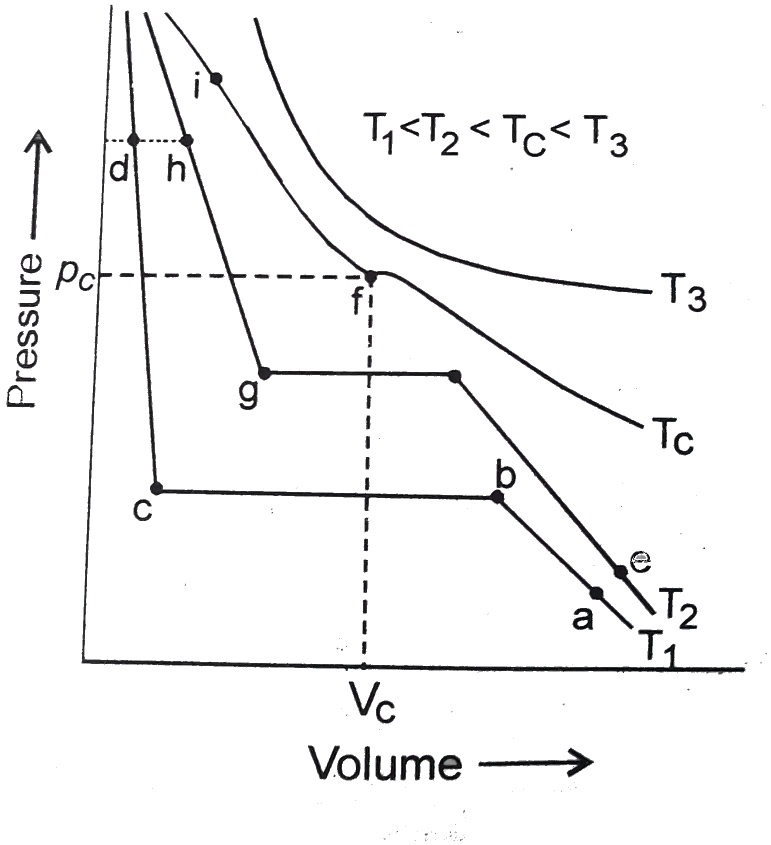
(i) In which state will CO_2 exist between the pointa a and b a temperature T_1?

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

(iii) At what point wil CO_2 be completely liquafied whe temperature is T_2.

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

(v) What portion of the isotherm at T_1 represents liquid and gaseous CO_2 at equilibrium ?



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2. The variation of vapour of different liquids with temperature is shown in figure

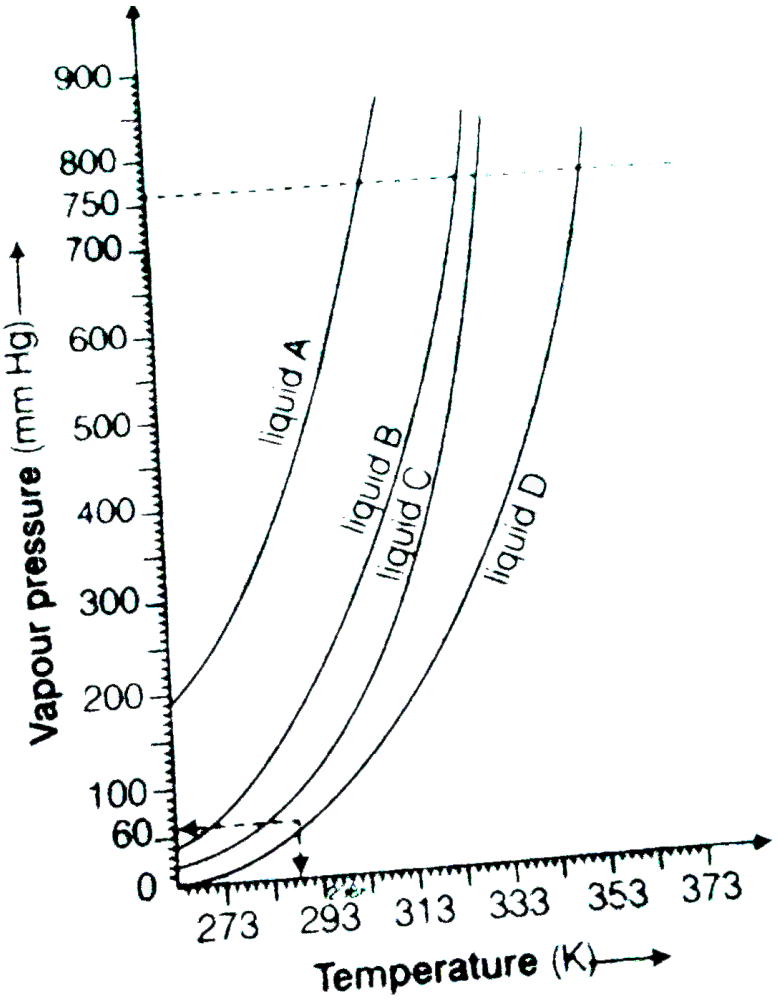
(i) Calculate graphically boiling points of liquids A and B.

(ii) If we take liquid c in a closed vessel and heat it continuously. At what temperature will it boil ?

(iii) At high altitude, atmospheric pressure is low (say 60 mm Hg). At what temperature liquid D boils ?

(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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6. The pressure and volume of gas are changed as shown in the P-V diagram in the figure ahead. The temperature of the gas :

Watch Video Solution

Revision Exercises Objective Questions Passage Based Questions

1. Deviation of real gases from ideal behaviour can be studied by plots of compressibility factor (Z) vs p. The copressibility factor is

$$Z = \frac{pV}{nRT}$$

The compressibility factor for 1 mole of a gas obeying van der Waals gas equation at $0^\circ C$ and 100 atm pressure is found to be 0.5. The van der Waals gas equation is

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

What is the value of Z for an ideal gas?

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2. Deviation of real gases from ideal behaviour can be studied by plots of compressibility factor (Z) vs p. The copressibility factor is

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The compressibility factor for 1 mole of a gas obeying van der Waals gas equation at $0^\circ C$ and 100 atm pressure is found to be 0.5. The van der Waals gas equation is

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

What is the volume of the gas?

Watch Video Solution

3. Deviation of real gases from ideal behaviour can be studied by plots of compressibility factor (Z) vs p. The copressibility factor is

$$Z=\frac{pV}{nRT}$$

The compressibility factor for 1 mole of a gas obeying van der Waals gas equation at $0^\circ C$ and 100 atm pressure is found to be 0.5. The van der Waals gas equation is

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

Calculate the value of 'a' assuming volume of molecules to be negligible.

Watch Video Solution

4. Deviation of real gases from ideal behaviour can be studied by plots of compressibility factor (Z) vs p. The copressibility factor is

$$Z = \frac{pV}{nRT}$$

The compressibility factor for 1 mole of a gas obeying van der Waals gas equation at $0^\circ C$ and 100 atm pressure is found to be 0.5. The van der Waals gas equation is

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

What is the significance of van der Waals constant 'a'?

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5. Deviation of real gases from ideal behaviour can be studied by plots of compressibility factor (Z) vs p. The copressibility factor is

$$Z = \frac{pV}{nRT}$$

The compressibility factor for 1 mole of a gas obeying van der Waals gas equation at $0^\circ C$ and 100 atm pressure is found to be 0.5. The van der Waals gas equation is

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

For gases like H_2 and He, which show only positive deviation from ideal behaviour, the compressibility factor is greater than 1. Is the statement true or false?

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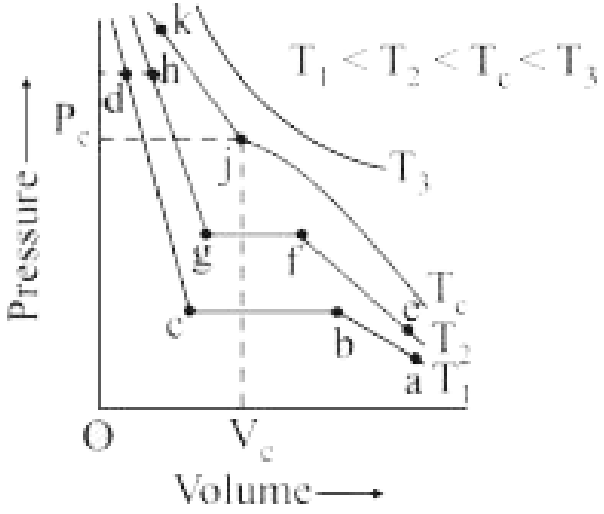
6. Isotherms of carbon dioxide at various temperatures are represented in figure. Answer the following questions based on this figure.



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

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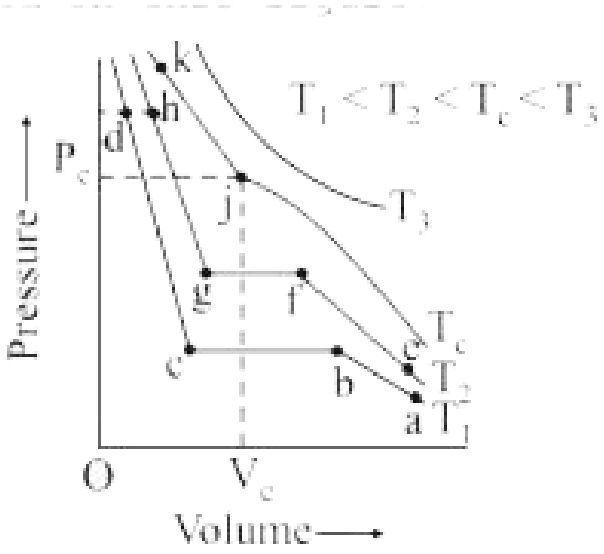
7. Isotherms of carbon dioxide at various temperatures are represented in figure. Answer the following questions based on this figure.



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

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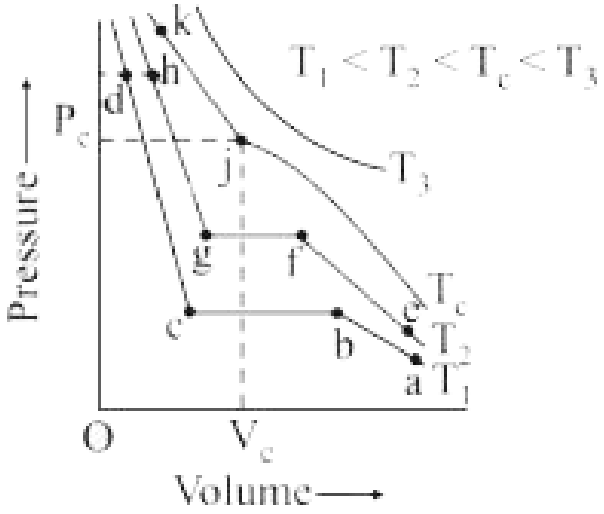
8. Isotherms of carbon dioxide at various temperatures are represented in figure. Answer the following questions based on this figure.



At what point will CO_2 be completely liquefied when temperature is T_2 ?

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9. The pressure and volume of gas are changed as shown in the P-V diagram in the figure ahead. The temperature of the gas :

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10. Assertion : Critical temperature of CO_2 is $304K$, it cannot be liquefied above 304 K.

Reason : At a certain temperature, volume $\propto 1/$ pressure.

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Revision Exercises Objective Questions True Or False Questions

1. No gas can exist in the gaseous state at $-273^\circ C$.

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2. Root mean square velocity of a gas is directly proportional to the absolute temperature of the gas.

Watch Video Solution

3. Greater the critical temperature of a gas, more easily the gas can be liquefied.

Watch Video Solution

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

Watch Video Solution

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

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

Watch Video Solution

7. Average kinetic energy of a gas is inversely proportional to the absolute temperature.

Watch Video Solution

8. For an ideal gas, the value of compressibility factor is zero.

Watch Video Solution

9. At the critical points, the densities of a substance in gaseous and liquid states become same.

Watch Video Solution

10. The graph between PV vs P at constant temperature is linear parallel to the pressure axis.

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Revision Exercises Objective Questions Fill In The Blanks Questions

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

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

Watch Video Solution

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

Watch Video Solution

4. The van der Waals constant ..... Measures the forces of attraction between the molecules of a gas.

Watch Video Solution

5. For H_2 and He, the compressibility factor always .....with increase in temperature.

Watch Video Solution

6. A real gas show ideal behaviour at :-

Watch Video Solution

7. The ratio of average molecular kinetic energy of CO_2 (molar mass 44) to that of SO_2 (molar mass 64) at $26^\circ C$ is equal to .....

Watch Video Solution

8. The compressibility factor for an ideal gas is

Watch Video Solution

9. The numerical value of R is .....$\mathrm{L\,atm\,K^{-1}mol^{-1}}$ and ..... $\mathrm{JK^{-1}\ \ mol^{-1}}$.

Watch Video Solution

10. According to Boyle's law if pressure of a gas is reduced to 1/4, then its volume will become ..... Times.

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Revision Exercises Objective Questions Assertion Reason Questions

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

Reason: Hydrogen bonding is present in ammonia.

A. Assertion and reason both are correct statements and reason is correct explanation for assertion.

B. Assertion and reason both are correct statements but reason is not correct explanation for assertion.

C. Assertion is correct statement but reason is wrong statement.

D. Assertion is wrong statement but reason is correct statement.

Answer: a

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2. Assertion : Liqefaction of H_2 and He are very difficult.

Reason : Critical temperature of H_2 and He gases are high.

A. Assertion and reason both are correct statements and reason is correct explanation for assertion.

B. Assertion and reason both are correct statements but reason is not correct explanation for assertion.

C. Assertion is correct statement but reason is wrong statement.

D. Assertion is wrong statement but reason is correct statement.

Answer: c

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3. Assertion : The pressure of real gas is less than the pressure of ideal gas. Reason : Intermolecular forces of attraction in real gases are greater than in ideal gas.

A. Assertion and reason both are correct statements and reason is correct explanation for assertion.

B. Assertion and reason both are correct statements but reason is not correct explanation for assertion.

C. Assertion is correct statement but reason is wrong statement.

D. Assertion is wrong statement but reason is correct statement.

Answer: d

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4. Assertion : For a certain amount of gas, at constant temperature the product pV is always constant.

Reason : This is statement of Charle's law.

A. Assertion and reason both are correct statements and reason is correct explanation for assertion.

B. Assertion and reason both are correct statements but reason is not correct explanation for assertion.

C. Assertion is correct statement but reason is wrong statement.

D. Assertion is wrong statement but reason is correct statement.

Answer: C

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5. Assertion : The root mean square velocity of an ideal gas at constant pressure varies with density as $1/\sqrt{d}$.

Reason : Average kinetic energy of a gas is directly proportional to the absolute temperature.

A. Assertion and reason both are correct statements and reason is correct explanation for assertion.

B. Assertion and reason both are correct statements but reason is not correct explanation for assertion.

C. Assertion is correct statement but reason is wrong statement.

D. Assertion is wrong statement but reason is correct statement.

Answer: b

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6. Assertion : At law pressure, van der Waals equation may be expressed as

$$pV = RT - \frac{a}{V}$$

Reason : At low pressure, b can be neglected in comparision to V.

A. Assertion and reason both are correct statements and reason is correct explanation for assertion.

B. Assertion and reason both are correct statements but reason is not correct explanation for assertion.

C. Assertion is correct statement but reason is wrong statement.

D. Assertion is wrong statement but reason is correct statement.

Answer: a

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7. Assertion : Compressibility factor of ideal gases is one.

Reason : For ideal gases $pV = nRT$ equation is obeyed.

A. Assertion and reason both are correct statements and reason is correct explanation for assertion.

B. Assertion and reason both are correct statements but reason is not correct explanation for assertion.

C. Assertion is correct statement but reason is wrong statement.

D. Assertion is wrong statement but reason is correct statement.

Answer: a

Watch Video Solution

8. Assertion : At critical point, the densities of gaseous and liquid states become same.

Reason : At critical point, gases behave ideally.

A. Assertion and reason both are correct statements and reason is correct explanation for assertion.

B. Assertion and reason both are correct statements but reason is not correct explanation for assertion.

C. Assertion is correct statement but reason is wrong statement.

D. Assertion is wrong statement but reason is correct statement.

Answer: a

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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.

A. Assertion and reason both are correct statements and reason is correct explanation for assertion.

B. Assertion and reason both are correct statements but reason is not correct explanation for assertion.

C. Assertion is correct statement but reason is wrong statement.

D. Assertion is wrong statement but reason is correct statement.

Answer: a

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

Reason: Molecular size of nitrogen is smaller than oxygen.

A. Assertion and reason both are correct statements and reason is correct explanation for assertion.

B. Assertion and reason both are correct statements but reason is not correct explanation for assertion.

C. Assertion is correct statement but reason is wrong statement.

D. Assertion is wrong statement but reason is correct statement.

Answer: c

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Revision Exercises Objective Questions Very Short Answer Questions

1. What is the value of temperature absolute zero is Celsius scale? How are the two scales related?

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2. What do you understand by standard temperature and pressure?

Watch Video Solution

Watch Video Solution

3. Define Boyle's law and Charles'w law.

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4. Which of the following represents the van der Walls equation for n moles of a real gas ?

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5. Gases do not settle at the bottom of a container. Explain.

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6. Name and state the law governing the expansion of gases when they are heated or cooled at constant pressure.

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7. How many elements are found as gases under normal conditions $(1atm \text{ and } 25^\circ C)$?

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8. What is the effect of temperature on the vapour pressure of a liquid?

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9. What is the effect of pressure on the boiling point of a liquid?

Watch Video Solution

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

Watch Video Solution

11. What is the ratio of root mean square speed and most probable speed?

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

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13. Define critical temperature.

Watch Video Solution

14. Arrange the following liquids in the increasing order of their normal boiling points :

$C_2H_5OH, (C_2H_5)_2O, H_2O.$

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15. Liquids like ether and acetone are kept in cool places.

Watch Video Solution

16. Why are hydrogen and helium not liquefied at room temperature?

Watch Video Solution

17. Warm water evaporates faster than cold water. Explain.

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18. Why cooling is caused by evaporation?

Watch Video Solution

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

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20. A rubber balloon permeable to hydrogen in all its isotopic forms is filled with deuterium (D_2) and then placed in a box containing pure hydrogen. Will the balloon expnad or contract or remains as it is ?

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

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

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23. What is meant by supercritial fluid?

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24. The critical temperatures of carbon dioxide and methane are $31.1^{\circ}C$ and $-81.9^{\circ}C$, respectively. Which of them has stronger intermolecular forces and why?

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

Watch Video Solution

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

Watch Video Solution

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

Watch Video Solution

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

Watch Video Solution

29. Name the universal gas constant. What is its value in SI unit ?

Watch Video Solution

30. What is the effect of temperature on surface tension and viscosity?

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Revision Exercises Objective Questions Short Answer Questions

1. How will you account for Charles' law on the basis of kinetic molecular theory of gases?

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2. State and explain Boyle's law and Charles' law. Derive gas equation from these laws.

Watch Video Solution

3. On the basis of intermolecular energy and thermal energy explain why?

(i) a solid has rigidity but a liquid does not have rigidty.

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

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4. Establish the relationship between temperature pressure and volume of a given mass of a gas.

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5. Write short notes on : Dalton's law of partial pressures and its applications.

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6. Deduce the gas equation $pV = nRT$ from different gas laws.

Watch Video Solution

7. Discuss the significance of gas constant R. Calculate its value of joules $K^{-1}\text{mol}^{-1}$.

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8. Define :

(i) Absolute zero

(ii) Standard temperature and pressure.

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9. Derive a relation between density and molar mass of the gas.

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10. 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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11. Justify the statement 'volume of a gas at a constant pressure decreases if its temperature is decreased.'

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12. What do you understand by the terms ideal gas and real gas ? Explain.

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13. Real gases behave ideally at:

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14. Comment on the statement that liquid state is an intermediate state between the gaseous state and the solid state.

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15. Would you expect surface tension and viscosity of a liquid to increases or decrease with increasing temperature? Explain.

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16. Why do gases deviate from ideal behaviour? Write van der Waal's equation for real gases stating significance of each term involved.

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17. Explain the physical significance of vanderWaals parameters.

Watch Video Solution

Watch Video Solution

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

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19. Define viscosity and coefficient of viscosity. How does the viscosity of liquids varies with temperature.

Watch Video Solution

20. What do you understand by surface tension of a liquid ? How does it vary with temperature?

Watch Video Solution

21. What is critical temperature ? What is its importance in liquefaction of gases?

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22. Why are certain liquids viscous while certain others are moblile?

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23. Define the following :

(i) Critical temperature (ii) Critical volume

(iii) Critical pressure

Watch Video Solution

24. In the van der Waals equation

Watch Video Solution

25. TRANSPORT OF CARBON DIOXIDE

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26. What is viscosity and coefficient of viscosity? What are SI units of coefficient of viscosity?

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27. Explain how does surface tension account for

(i) Capillary action of liquids

(ii) Spherical shape of liquid drops

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28. What do you understand by isobars, isotherms and isochores? Explain.

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29. Explain the following laws :

(i) Gay Lussac's law

(ii) Avogadro's law

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30. Explain : a gas can be changed into liquid or a liquid into a gas by a process in which a single phase is always present.

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31. Comment on the continuity between gaseous and liquid state.

Watch Video Solution

32. Out of NH_3 and N_2, which will have

(a) larger value of a

(b) larger value of b

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33. Derive the relationship between partial pressure of gas and total pressure of gas and mole fraction.

Watch Video Solution

34. What is compressibility factor ? How does it help to account for nature of a gas ?

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

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

(i) If pressure is taken in Nm^{-2}, number of moles in mol and volume in m^3, calculate the unit of 'a'.

(ii) What will be the unit of 'a' when pressure is in atmosphere and volume in dm^3?

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37. 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.

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Revision Exercises Objective Questions Long Answer Questions

1. Kinetic theory of gases

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2. Deduce the gas equation $pV = nRT$ from the gas laws. Discuss the significance of gas constant R. Calculate its value in $JK^{-1}\ \ \mathrm{mol}^{-1}$.

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3. What is an ideal gas? Why do the real gases show deviations from ideal behaviour?

Watch Video Solution

4. Define Charles' law and Dalton's law of partial pressure. How does kinetic molecular theory of gases account for these laws?

Watch Video Solution

5. What is liquid state of matter ? Discuss the following properties of liquids?

(i) Evaporation (ii) Boiling point
(iii) Viscosity (iv) Surface tension.

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6. Compare the three states of matter in terms of size and volume. Justify the statement that liquid state is intermediate state between solid state and gaseous state.

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7. Carbon monoxide gas is more dangerous than carbon dioxide gas. Why?

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8. What are critical constants? What are their significances?

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Revision Exercises Objective Questions Numerical Problems

1. What is the volume of a sample of oxygen at a pressure of 2.50 bar, if its volume is 3.15 L at 1.0 bar? (Assume constant temperature).

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2. At $450^{\circ}C$ and 723 mm pressure, 3.2 g of sulphur vapours occupy a volume of 780 mL. What is the molecular formula under these conditions?

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3. A 2 L vessel contains oxygen at a pressure of 380 mm Hg at $27^{\circ}C.140g$ of N_2 gas is introduced in the vessel. Will the pressure of gaseous mixture increase or decrease and do what extent?

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4. 250 mL of hydrogen measured at 750 mm of Hg have to be compressed into a vessel of 50 mL capacity at a constant temperature. Calculate the pressure required to do so.

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5. The mass of 500 mL of hydrogen gas at a pressure of 1 bar and at temperature of 300 K was found to be $4.09 \times 10^{-2} g$. Calculate the molar mass of hydrogen.

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6. 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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7. A 1.00 L evacuated flask is to be filled with CO_2 gas at 300° and a pressure of 500 mm Hg by placing a piece of dry ice, $CO_2(s)$ in the flask. What mass of dry ice should be used?

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8. A gas mixture of 3.0 L of propane and butane on complete combustion at $27^\circ C$ produced 10.0 L of CO_2. Find out the composition of the gas mixture.

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9. 0.64 g of an oxide of sulphur occupies 0.224 L at 2 bar and $273^\circ C$. Identify the compound. Also find out the mass of one molecule of the gas.

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10. A mixture of nitrogen and hydrogen gas has density $0.505 \times 10^{-3} \mathrm{g\ cm}^{-3}$ at 293 K and 750 mm Hg pressure.

What per cent of the mass is nitrogen?

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11. A toy balloon blown up at $5^{\circ} C$ has a volume of 480 mL. At this stage, the balloon is distended to 7/8th of its maximum stretching capacity.

(i) Will the balloon burst if it is brought to a room having temperature $30^{\circ} C$?

(ii) Calculate the temperature at which the balloon will burst.

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12. A mixture of H_2 and N_2 weighing 0.116 g is collected over water at $50^{\circ} C$ and occupies a volume of 275 mL when the total pressure is 1.0 atm. Calculate the precentage of H_2 and N_2 present. Calculated the vapour pressure of water at $50^{\circ} C$ is 92.5 torr.

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13. The cirtical constant for water are $374^{\circ}C$ 218 atm and 0.0566 liter mol^{-1} Calculate a,b and R .

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Higher Order Thinking Skills Advanced Level

1. 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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2. Distinguish between the total kinetic energy of a molecule and its translational kinetic energy. For what type of gas molecules are they

saem?

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3. Wet cold weather is much more penetrating than dry cold weather. Explain.

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4. Carbon dioxide is heavier than oxygen and nitrogen but it does not form the lower layer of the atmosphere. Explain.

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5. Explain why Boyle's law cannot be used to calculate the volume of a real gas when it is converted from its initial state to final state by an adiabatic expansion.

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6. 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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7. A given mass of a gas collected over water vapour at $25^{\circ}C$ has a pressure of $500mm\ Hg$. Calculate the pressure if its volume is reduced to half of its original volume (aqueous tension at $25^{\circ}C = 24\ \text{mm of Hg}$).

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8. For an ideal gas number of moles per litre in terms of its pressure P gas contant R and temperature T is .

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9. When $2g$ of a gas A is introduced into an evacuated flask kept at $25^\circ C$, the pressure is found to be $1atm$. If $3g$ of another gas B is then heated in the same flask, the total pressure becomes $1.5atm$. Assuming ideal gas behaviour, calculate the ratio of the molecular weights M_A and M_B.

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10. A ballon of diameter 20 metre weighs $100kg$ Calculate its pay-load if its is filled with He at 1.0 atm and $27^\circ C$ Density of air is $1.2kg,^{-3}$ $\left[R = 0.082dm^3 \text{ atm } K^{-1}mo1^{-1}\right]$.

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11. At $27^\circ C$, hydrogen is leaked through a tiny hole into a vessel for 20 min . Another unknown gas at the same temperature and pressure as that of hydrogen is leaked through the same hole for 20 min . After the effusion of the gases, the mixture exerts a pressure of $6atm$. The

hydrogen content of the mixture is $0.7mol$. If the volume of the container is $3L$, what is the molecular weight of the unknown gas?

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12. 20 dm^3 of SO_2 diffuse through a porous partition in 60 s. what volume of O_2 will diffuse under similar conditions in 30 s ?

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13. An evacuated glass vessel weighs $50.0g$ when empty, $148.0g$ when filled with a liquid of density $0.98gmL^{-1}$, and $50.5g$ when filled with an ideal gas at $760mmHg$ at $300K$. Determine the molar mass of the gas.

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14. 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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15. Calculate the total pressure in a 10 litre cylinder which contains $0.4g$ of helium, $1.6g$ of oxygen and $1.4g$ of nitrogen at $27^\circ C$. Also calculate the partial pressure of helium gas in the cylinder. Assume ideal behaviour of gases. Given $R = 0.082$ litre atm $K^{-1}mol^{-1}$.

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16. A fluoride of phosphorus in the gaseous state was found to diffuse more slowly by a factor of 2.12 than nitorgen under the same conditions. Calculate the molecular weight of this fluoirde. If it contains only one phosphorus atom, write its molecular formula.

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17. A mixture in which the mole ratio of H_2 and O_2 is $2:1$ is used to prepare water by the reaction.

$2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(g)}$

The total pressure in the container is $0.8atm$ at $20^\circ C$ before the reaction. Determine the final pressure at $120^\circ C$ after reaction assuming $80\,\%$ yield of water.

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18. A plant virus is found to consist of uniform cylindrical particle of 150Å in diameter 5000 Å long. The specific volume of the virus is 0.75 mLg^{-1}. If the virus is considered to be a single particle, find its molar mass.

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19. 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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Competition File Objective Type Questions A Multiple Choice Questions

1. Gas that can not be collected over water is:

A. Gay Lussac's law

B. Dalton's law of partial pressures

C. Boyle's law

D. Avogadro's hypothesis.

Answer: B

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2. 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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3. The temperature of a gas in a closed container is 27°C. If the temperature is raised to 327°C the pressure exerted is :

A. reduced to half

B. doubled

C. reduced to one-third

D. cannot be calculated from the given information.

Answer: B

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4. A gas at $10^{\circ}C$ occupies a volume of 283mL. If it is heated to $20^{\circ}C$, keeping the pressure constant, the new volume will be _____.

A. 283 mL

B. 293 mL

C. 566 mL

D. cannot be calculated from the given information.

Answer: B

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5. At constant temperature, the pressure of V mL of a dry gas was increased from 1 atm to 2 atm. The new volume will be :

A. 2V

B. $V/2$

C. V^2

D. $V/4$

Answer: B

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6. Equal masses of CH_4 and H_2 are mixed in an empty chamber. The partial pressure of hydrogen in this chamber expressed as fraction of total pressure is :

A. $1/2$

B. $8/19$

C. $1/9$

D. $\frac{8}{9}$

Answer: D

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

A. Xe

B. CO_2

C. C_2H_6

D. CH_4

Answer: B

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8. 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 interacting 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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9. For a given mass of a gas at constant temperature, if the volume V becomes three times, then the pressure (p) will become :

A. $3p$

B. $p/3$

C. $3p/T$

D. $9p^2$

Answer: B

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10. An open vessel at 37°C is heated until $3/5$ of the air in it has been expelled. Assuming that the volume of the vessel remains constant, the temperature to which the vessel is heated is :

A. 502°C

B. 502 K

C. 243.67°

D. 92.5°C

Answer: A

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11. If air contains N_2 and O_2 in volume ratio $4:1$, the average vapour density of air is:

A. 14.4

B. 15.5

C. 16.5

D. 29

Answer: A

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12. The gases H_2, N_2, O_2 and NH_3 will diffuse in the order :

A. $H_2 > N_2 > O_2 > NH_3$

B. $NH_3 > O_2 > N_2 > H_2$

C. $H_2 > N_2 > NH_3 > O_2$

D. $H_2 > NH_3 > N_2 > O_2$

Answer: D

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13. In what ratio by mass, sulphur trioxide and nitrogen should be mixed so that partial pressure exerted by each gas is same ?

A. $7:20$

B. $7:40$

C. $20:7$

D. $40:7$

Answer: C

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14. $20\ \%\ N_2O_4$ molecules are dissociated in a sample of gas at $27^\circ C$ and 760 torr. Calculate the density of the equilibrium mixture.

A. $3.1gL^{-1}$

B. $6.2gL^{-1}$

C. $12.4gL^{-1}$

D. $18.6gL^{-1}$

Answer: A

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15. 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

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16. A person living in Shimla observed 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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17. On a humid day, the mole fraction of water vapour in air at 298 K is 0.0265 bar. If total vapour pressure of air is 0.980 bar and vapour pressure of water at 298 K is 0.0315 bar, the relative humidity is

A. 82.5

B. 88.6

C. 76.4

D. 28.5

Answer: A

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18. The pyknometric density of $NaCl$ crystal is $2.165 \times 10^{3kgm^{-3}}$ while its X-ray density is $2.178 \times 10^{-3} kgm^{-3}$. The fraction of unoccupied sites in $NaCl$ crystal is

a. 5.96 b. 5.96×10^{-2}

c. 5.96×10^{-1} d. 5.96×10^{-3}

A. 5.96

B. 5.96×10^{-2}

C. 0.596

D. 5.96×10^{-3}

Answer: D

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19. The rate of diffusion of methane is twice that of X. The molecular mass of X is

A. 16

B. 32

C. 80

D. 64

Answer: D

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20. Boyle's law may be expressed as

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

A. $1.086:1$

B. $1:1.086$

C. $2:1.086$

D. $1.086:2$

Answer: A

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22. The ratio of average speed of an oxygen molecule to the r.m.s. speed of a N_2 molecule at the same temperature is :

A. $\left(\frac{3\pi}{7}\right)^{1/2}$

B. $\left(\frac{7}{3\pi}\right)^{1/2}$

C. $\left(\frac{3}{7\pi}\right)^{1/2}$

D. $\left(\frac{7\pi}{3}\right)^{\frac{1}{2}}$

Answer: B

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23. The molecules of a gas A travel four times faster than the molecules of gas B at same temperature. The ratio of molecular weights (M_A/M_B) is

A. 16

B. $1/16$

C. 4

D. $1/4$

Answer: B

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24. The RMS velocity of CH_4 will become double its value at STP when the temperature is :

A. 546 K

B. $819^\circ C$

C. $546^\circ C$

D. 819 K

Answer: B

Watch Video Solution

25. The temperature at which hydrogen molecules have the same kinetic energy as oxygen molecules have at $40^\circ C$ is :

A. $40^\circ C$

B. $5^\circ C$

C. $320^\circ C$

D. $640^\circ C$

Answer: A

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26. The molecular velocities of two gases at same temperature are u_1 and u_2, their masses are m_1 and m_2 respectively, which of the following expression is correct ?

A. $\frac{m_1}{v_1^2} = \frac{m_2}{v_2^2}$

B. $m_1 v_1 = m_2 v_2$

C. $\frac{m_1}{v_1} = \frac{m_2}{v_2}$

D. $m_1 v_1^2 = m_2 v_2^2$

Answer: D

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

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

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

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

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

Answer: C

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28. 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. 375 K

B. 666.7 K

C. 573 K

D. 500 K

Answer: B

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29. 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. $313/293$

B. $313/293$

C. $1/2$

D. 2

Answer: A

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30. 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 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

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31. A gas will approach ideal behaviour at

A. low pressure and low temperature

B. low pressure and high temperature

C. high pressure and low temperature

D. high pressure and high temperature

Answer: B

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32. The van der Waals' equation accounts for :

A. the intermolecular forces only

B. the actual volume of the molecules only

C. both the intermolecular forces and the molecular volume

D. neither the intermolecular forces nor the molecular volume.

Answer: C

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33. In van der Waal's equation of state for non ideal gas, the term which accounts for the intermolecular forces is

A. aV^2

B. b

C. RT

D. $1/RT$

Answer: A

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34. At extremely low pressure the Van der Waals equation of one mole may be written as :

A. $pV = RT + pb$

B. $(p + a)(V - b) = RT$

C. $pV = RT - \frac{a}{V}$

D. $pV = RT$

Answer: C

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35. The value of van der Waals constant 'a' for N_2 and NH_3 are 1.39 and 4.17 atm $L^2 mol^{-2}$ respectively. If these two gases have the same value of constant 'b' then under similar conditions :

A. The pressure exerted by N_2 gas is more than that of NH_3

B. The pressure exerted by nitrogen is less than that of NH_3

C. Both exert equal pressure

D. None of these.

Answer: A

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36. Why liquids diffuse slowly as compared to gases?

A. liquids have no definite shape

B. the molecules of liquid are heavy

C. the molecules of liquid move fast

D. the molecules are held together by strong intermolecular forces.

Answer: D

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37. On heating the viscosity of liquid sulphur are

A. increases

B. decreases

C. remains same

D. is reduced to zero.

Answer: B

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38. At the higher altitudes the boiling point of water lowers because

A. temperature is low

B. atmospheric pressure is low

C. atmospheric pressure is high

D. none of these

Answer: B

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39. The heats of vaporization of $H_2O, C_2H_5OH \text{and} CS_2 \text{are } 40.6 \text{ kJ} mol^{-1}, 38.6 kJ mol^{-1} \text{and} 26.8 kJ mol^{-1}$

respectively. The strength of intermolecular forces in these liquids is in the order of _____.

A. $H_2O > C_2H_5OH > CS_2$

B. $CS_2 > C_2H_5OH > H_2O$

C. $H_2O > CS_2 > C_2H_5OH$

D. $CS_2 > H_2O > C_2H_5OH$

Answer: A

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40. 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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41. The surface tension of which of the following liquid is maximum?

A. C_2H_5OH

B. CH_3OH

C. H_2O

D. C_6H_6

Answer: C

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1. If the ration of the masses of SO_3 and O_2 gases confined in a vessel is $1:1$, then the ratio of their partial pressure would be

A. $5:2$

B. $2:5$

C. $2:1$

D. $1:2$

Answer: B

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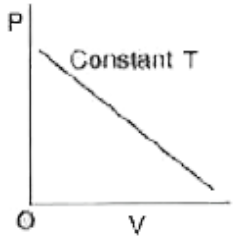
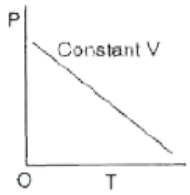
2. Which of the following diagrams correctly decribes the behavior of a fixed mass of an ideal gas ? (T is measured in K)

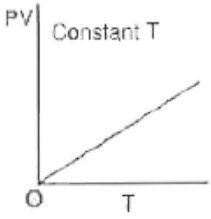
A.



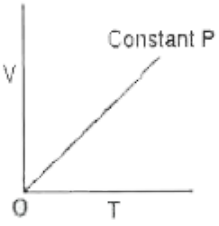
B.



C.



D.



Answer:

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3. 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. a white ring is formed at the centre of the tube

B. a white ring is formed near the ammonia bottle

C. entire length of tube turns white

D. a white ring is formed near HCl bottle

Answer: D

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4. 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. 3.6 bar

D. 1.6 bar

Answer: B

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

A. kinetic energy of molecules decreases

B. pressure of gas increases

C. kinetic energy of molecules remains the same

D. number of molecules of gas increases

Answer: C

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6. Critical temperature of H_2O, NH_3, CO_2 and O_2 are 647 K, 405.6 K, 304.10 K and 1542 K respectively. If the cooling starts from 500 K to their critical temperature, the gas that lilquiefies first is

A. H_2O

B. NH_3

C. CO_2

D. O_2

Answer: A

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7. 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 greater by a factor of 0.70

Answer: B

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8. The incorrect statement among the following

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

B. The vapour pressure of a liquid is constant at constant temperature.

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

D. The boiling point of a liquid is the same at all external pressure.

Answer: D

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9. 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. 123.75

D. 43.87

Answer: A

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10. The mass of $2.24 \times 10^{-3}m^3$ of a gas is 4.4 g at 273.15 K and 101.325 Kpa pressure. The gas may be

A. NO

B. NO_2

C. C_3H_8

D. NH_3

Answer: C

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11. 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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12. A gaseous mixture was prepared by taking equal moles of CO and N_2. If the total pressure of the mixture was found to be 1 atomosphere, the partical pressure of the nitrogen (N_2) in the mixture is

A. 0.5 atm

B. 0.8 atm

C. 0.9 atm

D. 1 atm

Answer: A

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13. 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. 50.0 u

B. 12.25 u

C. 6.50 u

D. 25.0 u

Answer: B

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

A. 2

B. 2.8

C. 4

D. 1.4

Answer: D

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15. A mixture contains 64 g of dioxygen and 60 g of neon at a total pressure of 10 Bar. The partial pressure in bar of dioxygen and neon are respectively (atomic masses $O = 16, Ne = 20$)

A. 4 and 6

B. 6 and 4

C. 5 and 5

D. 8 and 2

Answer: A

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16. 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 is Jm^{-2}

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

Answer: B

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17. The gas with the highest critical temperature is

A. H_2

B. He

C. N_2

D. CO_2

Answer: D

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18. 50 mL of each gas A and of gas B takes 150 and 200 seconds respectively for effusing through a pin hole under the similar conditions. If molecular mass of gas A is 36, the molecular mass of gas B will be

A. 96

B. 128

C. 32

D. 64

Answer: D

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19. The compressibility factor for a real gas at high pressure is .

A. 1

B. $1 + pb/RT$

C. $1 - pb/RT$

D. $1 + RT/pb$

Answer: B

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20. The average energy per molecule of a gas at a given temperature, T, is given by

A. $\frac{3}{2}RT$

B. $\sqrt{\frac{3RT}{M}}$

C. $\sqrt{\frac{8(R/N_A)T}{\pi M}}$

D. $\frac{3}{2}\left(\frac{R}{N_A}\right)T$

Answer: D

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21. When 4 g of an ideal gas A is introduced into an evacuated flask kept at $25^\circ C$, the pressure is found to be one atmosphere. If 6 g of another ideal gas B is then added to the same flask, the pressure becomes 2 atm at same temperature. The ratio of molecular weights $(M_A : M_B)$ of the two gases would be

A. $1:2$

B. $2:1$

C. $2:3$

D. $3:2$

Answer: C

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22. The volume of neon gas in cm at STP having the same number of atoms as that present in 800 mg of Ca is (At. mass : $Ca = 40gmol^{-1}, Ne = 20gmol^{-1}$)

A. 56

B. 896

C. 224

D. 448

Answer: D

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23. Which of the following is not the postulate of the kinetic theory of gases?

A. Gas molecules are in a permanent state of random motion.

B. Pressure of gas is due to molecular impacts on the walls

C. The molecules are perfectly elastic

D. The molecular collisions are elastic

Answer: C

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24. Maximum deviation from ideal gas is expected from

A. $CH_4(g)$

B. $NH_3(g)$

C. $H_2(g)$

D. $N_2(g)$

Answer: B

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

A. HCl and He atoms

B. SiF_4 and He atoms

C. H_2O and alcohol

D. Cl_2 and CCI_4

Answer: A

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26. 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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27. 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. $16:8:1$

D. $16:2:1$

Answer: D

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

A. high temperatures and high pressures.

B. low temperatures and low pressures.

C. high temperatures and low pressures.

D. low temperatures and high pressures.

Answer: C

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29. 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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30. 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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31. 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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32. A gas at 350 K and 15 bar has molar volume 20 percent smaller than that for an ideal gas under the same conditions. The correct option above the gas and its compressibility factor (Z) is :

A. $Z < 1$ and repulsive forces are dominant

B. $Z > 1$ and attractive forces are dominant

C. $Z > 1$ and repulsive forces are dominant

D. $Z < 1$ and attractive forces are dominant

Answer: D

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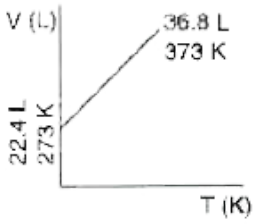
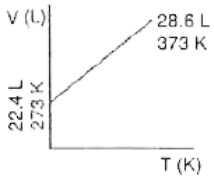
Competition File Objective Type Questions B Multiple Choice Questions Jee Main Other State Boards For Engineering Entrance

1. 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.



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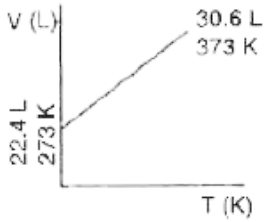
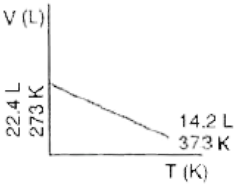


D.



Answer: C

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2. Equal masses of methane and oxygen are mixed in an empty container at $25^\circ C$. The fraction of the total pressure exerted by oxygen is:

A. $\frac{1}{3} \times \frac{273}{298}$

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

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

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

Answer: B

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3. 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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4. 100 mL of O_2 and H_2 are kept at same temperature and pressure. What is true about their number of molecules ?

A. $N_{O_2} > N_{H_2}$

B. $N_{O_2} < N_{H_2}$

C. $N_{O_2} = N_{H_2}$

D. $N_{O_2} + N_{H_2}$ = 1 mole

Answer: C

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

A. $900m/s$

B. $120m/s$

C. $300m/s$

D. $600 m / s$

Answer: D

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

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

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

Answer: C

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7. 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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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 velocity by 2 times

C. increases the rms velocity by two times

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

Answer: D

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9. 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. $5.56 \times 10^{-2}mol$

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

Answer: B

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

A. $T_{N_2} = T_{H_2}$

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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11. 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 and b forCl_2 lt a and 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 for $Cl_2 > af$ or C_(2)H_(6)$butbf$ or Cl_(2) lt bf or C_(2)H_(6)`

Answer: D

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12. Two vessels of volumes 16.4 L and 5 L contain two ideal gases of molecular existence at the respective temperature of $27^\circ C$ and $227^\circ C$ and exert 1.5 and 4.1 atmospheres respectively. The ratio of the number of molecules of the former to that of the latter is

A. 2

B. 1

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

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

Answer: A

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

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

Answer: D

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14. At a certain temperature, the time required for the complete diffusion of 200 mL of H_2 gas is 30 minutes. The time required for the complete diffusion of 50 mL of O_2 gas at the same temperature will be

A. 60 minutes

B. 45 minutes

C. 30 minutes

D. 15 minutes

Answer: B

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15. Four gases P, Q, R andS have almost same values of 'b' but their 'a' values (a, b are van der Waals constants) are in the order $Q < R < S < P$. At a particular temperature, among the four gases the most easily liquefiable one is

A. P

B. Q

C. R

D. S

Answer: A

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16. If two moles of an ideal gas at 500 K occupies a volume of 41 litres, the pressure of the gas is $\left(R = 0.082 L atm K^{-1} mol^{-1}\right)$

A. 2 atm

B. 3 atm

C. 4 atm

D. 5 atm

Answer: A

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17. At 273 K, the density of a certain gaseous oxide at 2 atmosphere is same as that of dioxygen at 5 atmosphere. The molecular mass of the oxide $\left(\text{in g mol}^{-1}\right)$ is

A. 80

B. 64

C. 70

D. 160

Answer: A

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18. Density of carbon monoxide is maximum at

A. 2 atm and 600 K

B. 0.5 atm and 273 K

C. 6 atm and 1092 K

D. 4 atm and 500K

Answer: D

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19. 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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20. One mole of N_2O_4 gas at 300 K is kept in a closed container at 1 atm. It is heated to 600 K when $20\,\%$ of N_2O_4 decomposes to $NO_2(g)$. The resultant pressure in the container would be

A. 1.2 atm

B. 2.4 atm

C. 2.0 atm

D. 1.0 atm

Answer: B

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21. The units of surface tension and viscosity of liquids are respectively

A. $kgm^{-1}s^{-1}$, Nm^{-1}

B. kgs^{-2}, $kgm^{-1}s^{-1}$

C. $Nm^{-1}, kgm^{-1}s^{-2}$

D. $kgs^{-1}, kgm^{-2}s^{-1}$

Answer: B

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22. A gas can be liquefied at temperature T and pressure P provided _____.

A. $T > T_c$ and $P > P_c$

B. $T < T_c$ and $P > P_c$

C. $T > T_c$ and $P > P_c$

D. $T > T_c$ and $P < P_c$

Answer: B

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23. The rms velocity of CO gas molecules at $27^{\circ}C$ is approximately $1000m/s$. For N_2 molecules at 600 K the rms velocity is approximately

A. $2000m/s$

B. $1414m/s$

C. $1000m/s$

D. $1500m/s$

Answer: B

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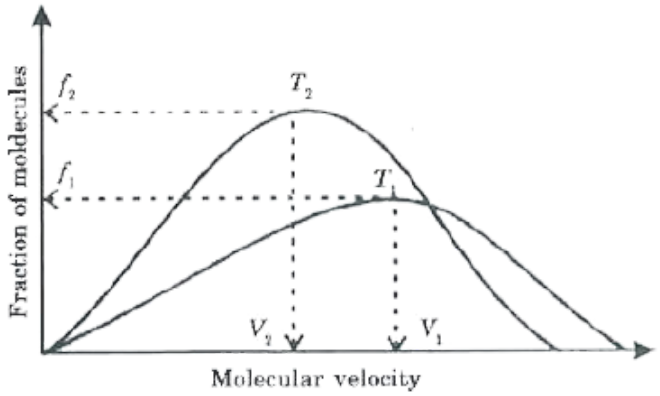
24. Plot of Maxwell's distribution of velocities is given below:

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

A. London force

B. hydrogen bond

C. ion-ion interaction

D. ion-dipole interaction.

Answer: B

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26. Dipole-dipole interaction energy between polar molecules in solids depends on the radius of the molecule (r) and it is directly proportional to

A. $\left(1/r^2\right)$

B. $\left(1/r^6\right)$

C. $\left(1/r\right)$

D. $\left(1/r^3\right)$

Answer: D

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27. A liquid can exist only

A. between triple point and critical point

B. at any temperature above melting point

C. between melting point and critical point

D. between boiling and melting points

Answer: D

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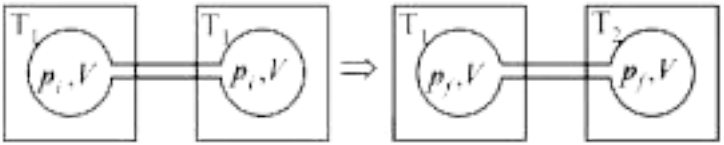
28. Two closed bulbs of equal volume (V) containing an ideal gas initially at pressure p_i and temperature T_1 are connected through a narrow tube of negligible volume as shown in the figure below. The temperature of

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. $1p_i\left(\frac{T_1T_2}{T_1+T_2}\right)$

Answer: C

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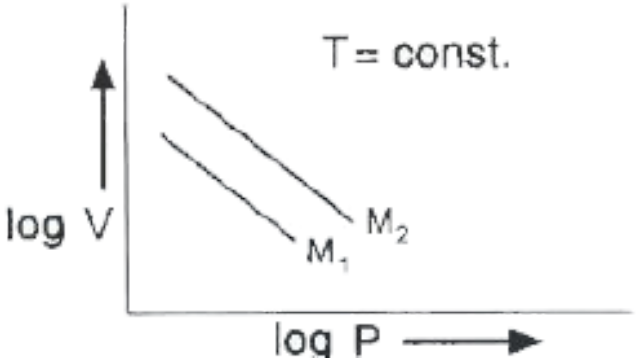
29. For same mass of two different ideal gases of molecular weights M_1 and M_2 plots of log V vs log P at a given constant temperature are

shown. Identify the correct option.



A. $M_1 > M_2$

B. $M_1 = M_2$

C. $M_1 < M_2$

D. Can be predicted only if temperature is known

Answer: A

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30. The dimension ML^0T^{-2} corresponds to .

A. Coefficient of viscosity

B. Surface tension

C. Vapour pressure

D. Kinetic energy

Answer: B

Watch Video Solution

31. A gas will approach ideal behaviour at

A. low temperature and low pressure

B. low temperature and high pressure

C. high temperature and low pressure

D. high temperature and high pressure

Answer: C

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32. What will be the relation between the T_1 of gas 1 with $M_1 = 56$ and T_2 of gas 2 with $M_2 = 44$ if the average speed of gas 1 is equal to most probable speed of gas 2?

A. $T_1 = T_2^2$

B. $T_1 = T_2$

C. $T_1 = (T_2)^{1/2}$

D. $T_1 = 1/T_2$

Answer: B

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33. Which equation will explain the nature of PV versus P curve for CO_2 gas at moderately low pressure?

A. $PV = RT + Pb$

B. $PV = RT + a/V$

C. $PV = RT - a/V$

D. PV = RT - aV

Answer: C

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34. The value of compressibility factor (Z) for an ideal gas is

A. 0

B. 1

C. -1

D. 2

Answer: B

Watch Video Solution

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

A. $1:2$

B. $1:1$

C. $1:16$

D. $15:16$

Answer: D

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36. An open vessel at $27^{\circ}C$ is heated untill two fifth of the air (assumed as an ideal gas) in it has escaped from the vessel. Assuming that the volume of the vessel remains constant, the temperature at which the vessel has been heated is :

A. $750^{\circ} C$

B. $500^{\circ} C$

C. 750 K

D. 500 K

Answer: D

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37. The volume of gas A is twice than that of gas B. The compressibility factor of gas A is thrice than that of gas B at same temperature. The pressures of the gases for equal number of moles are:

A. $P_A = 2P_B$

B. $P_A = 3P_B$

C. $3P_A = 2P_B$

D. $2P_A = 3P_B$

Answer: D

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38. Which of the following equations does not represent Charles' law for a given mass of gas at constant pressure?

A. $\frac{V}{T} = K$

B. log V = log K+ log T

C. log K = log V + log T

D. $\frac{d(InV)}{dt} = \frac{1}{T}$

Answer: C

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39. Rare gases are sparingly soluble in water because of

A. hydrogen bonding

B. dipole-dipole intrarction

C. induced dipole-induced dipole interaction

D. dipole-induced dipole interaction

Answer: D

View Text Solution

40. The volume of gas A is twice than that of gas B. The compressibility factor of gas A is thrice than that of gas B at same temperature. The pressures of the gases for equal number of moles are:

A. $P_A = 2P_B$

B. $P_A = 3P_B$

C. $3P_A = 2P_B$

D. $2P_A = 3P_B$

Answer: D

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41. Consider the van der Waals constants, a and b, for the following gases.

Gas	Ar	Ne	Kr	Xe
$a/(\text{atm dm}^3\text{mol}^{-2})$	1.3	0.2	5.1	4.1
$b/(10^{-2}\text{dm}^6\text{mol}^{-1})$	3.2	1.7	1.0	5.0

Which gas is expected to have the highest critical temperature?

A. Kr

B. Ne

C. Ar

D. Xe

Answer: A

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42. 0.5 moles of gas A and x moles of gas B exert a pressure of 200 Pa in a container of volume $10m^3$ at 1000K. Given R is the gas constant in jk^{-1} ,x is :

A. $\frac{2R}{4+R}$

B. $\frac{2R}{4-R}$

C. $\frac{4-R}{2R}$

D. $\frac{4+R}{2R}$

Answer: C

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43. An open vessel at $27^\circ C$ is heated untill two fifth of the air (assumed as an ideal gas) in it has escaped from the vessel. Assuming that the volume of the vessel remains constant, the temperature at which the vessel has been heated is :

A. $750^\circ C$

B. $500^\circ C$

C. 750 K

D. 500 K

Answer: D

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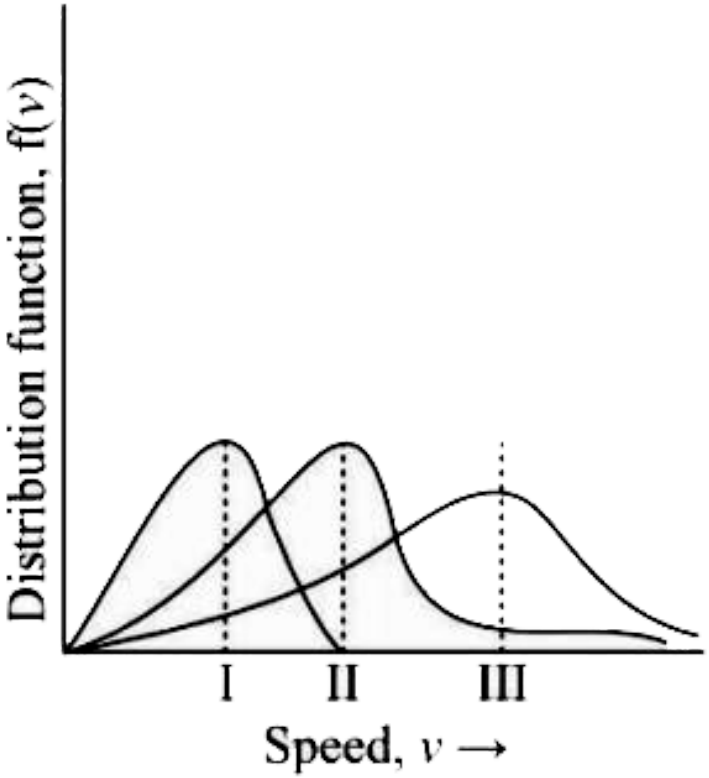
44. Points I, II and III in the following plot respectively correspond to (V_{mp}: most probable velocity)



A. V_{mp} of $N_2(300K)$, V_{mp} of $H_2(300K)$, V_{mp} of $O_2(400K)$

B. V_{mp} of $H_2(300K)$, V_{mp} of $N_2(300K)$, V_{mp} of $O_2(400K)$

C. V_{mp} of $O_2(300K)$, V_{mp} of $N_2(300K)$, V_{mp} of $H_2(400K)$

D. V_{mp} of $N_2(300K)$, V_{mp} of $O_2(300K)$, V_{mp} of $H_2(400K)$

Answer: D

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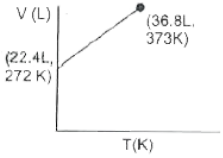
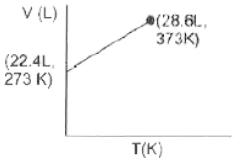
Competition File Objective Type Questions B Multiple Choice Questions Jee Advanced For Iit Entrance

1. Which of the following volume-temperature $(V - I)$ plots represents the behaviour of 1mole of an ideal gas at the atmospheric pressure?

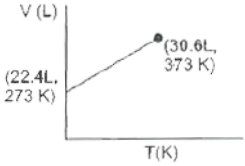
A.



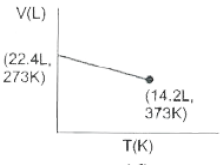
B.



C.



D.



Answer: C

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2. Positive deviation from ideal behaviour takes place because of

A. molecular interaction between atoms and $pV/nRT > 1$

B. molecular interactions between atoms and $pV/nRT < 1$

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

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

Answer: A

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3. 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. $u_{\mathrm{r.m.s}} = \sqrt{\frac{3E}{2M}}$

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

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

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

Answer: C

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4. The ratio of the rate of diffusion of helium and methane under indentical conditions of pressure and temperature will be

A. 4

B. 2

C. 1

D. 0.5

Answer: B

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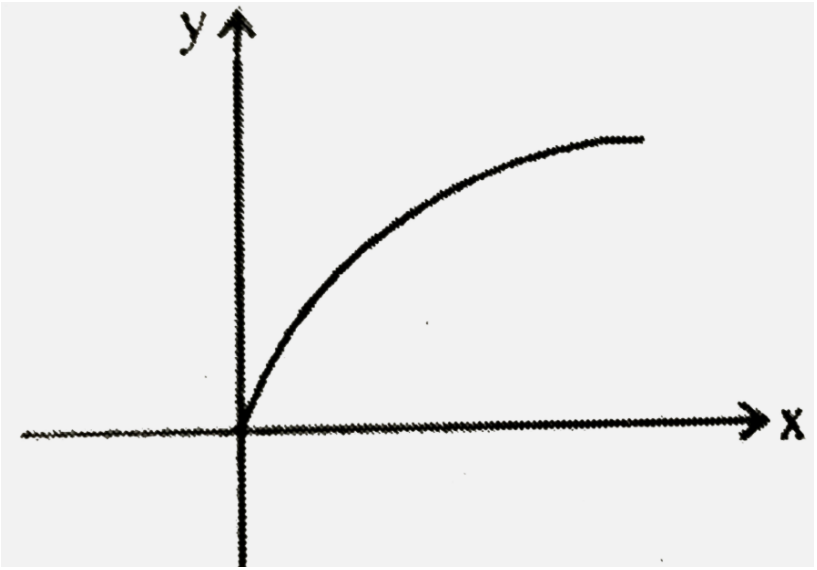
5. 

A. For a gas A, a = 0, and Z will linearly depend on pressure.

B. For gas B, b= 0, and Z will linearly depend on pressure.

C. Gas C is a real gas and we can find 'a' and b' if intersection data is given.

D. All van der Waals gases will behave like gas C and gives positive slope at high pressure.

Answer: B

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6. 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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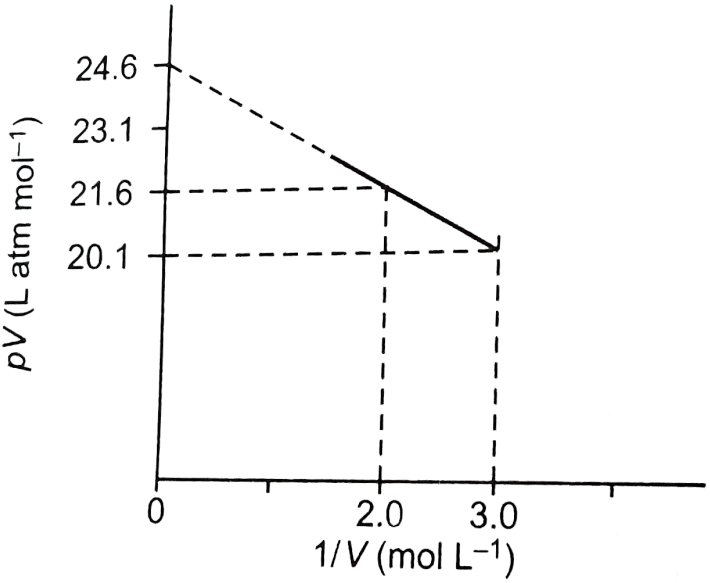
7. For one mole of a van der Waals' gas when $b = 0$ and $T = 300K$, the $pVvs1/V$ plot is shown below. The value of the vander Waals' constant a

(atm $Lmol^{-2}$)



A. 1

B. 4.5

C. 1.5

D. 3

Answer: C

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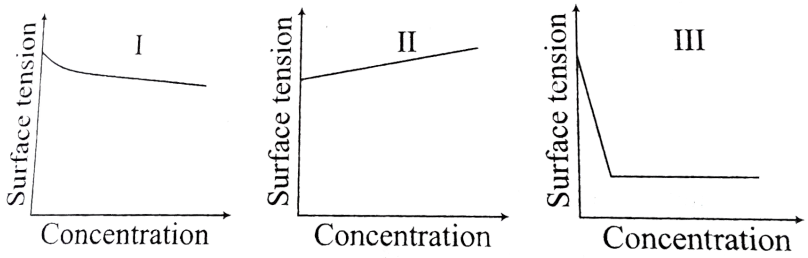
8. The equalitative sketches I, II and III given below show the variation of surface tension with molar concentration of three diferent aqueous solutions of KCl, CH_3OH and $CH_3(CH_2)_{11}OSO_3^-Na^+$ at room temperature.



The correct assignment of the sketches is

A. $I: KCl II: CH_3OH III: CH_3(CH_2)_{11}OSO_3^-Na^+$

B. $I: CH_3(CH_2)_{11}OSO_3^-Na^+ II: CH_3OH III: KCl$

C. $I: KCl II: CH_3(CH_2)_{11}OSO_3^-Na^+ III: CH_3OH$

D. $I: CH_3OH II: KCl III: CH_3(CH_2)_{11}OSO_3^-Na^+$

Answer: D

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Competition File Objective Type Questions C Multiple Choice Questions

1. Which of the following statements is / are correct ?

A. At constant temperature, the gas density is directly proportional to pressure.

B. At higher pressures, gases deviate from Boyle's law.

C. Plots of p vs T at constant volumes for an ideal gas are parabolic.

D. At -273 K gases have zero volume which corresponds to solid state.

Answer: A::B

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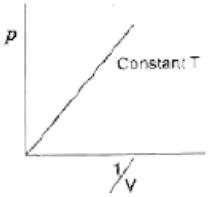
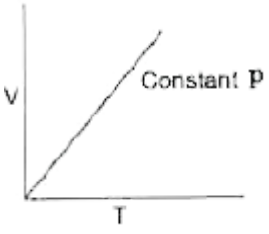
2. Which of the following plots are correct for an ideal gas ?

A.

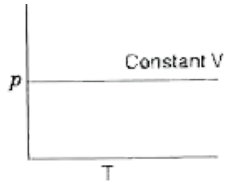


B.

C.



D.



Answer: A::C

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3. Which of the following statements is not correct?

A. Surface tension of liquids decreases with increase of temperature.

B. The viscosity of a liquid increases with decrease of temperature.

C. Liquids diffuse faster than gases.

D. Gases can be liquefied only above their critical temperatures.

Answer: C::D

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4. VAN DER WAALS EQUATION

A. At very low pressure, van der Waals' equation becomes pV = RT.

B. At high pressure, compressibility is greater than one.

C. At moderate pressures, compressibility is greater than one.

D. Units of van der Waals' constant 'a' are $atmL^2mol^{-2}$.

Answer: B::C

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5. A gas described by van der Waals equation .

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

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

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

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

Answer: A::C::D

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6. 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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7. 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

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8. According to kinetic theory of gases:

A. collisions are always elastic

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

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

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

Answer: A::B::D

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9. Two gases X $(mol.\ wt.\ M_X)$ and Y $(mol.\ wt.\ M_Y, M_Y > M_X)$ are at the same temperature T in two different containers. Their root mean square velocities are C_X and C_Y respectively. If the. average kinetic

energies per molecule of two gases X and Y are E_X and E_Y respectively, then which of the following relation (s) is (are) true ?

A. $E_x > E_y$

B. $C_x > C_Y$

C. $E_x = E_Y = \frac{3}{2}RT$

D. $E_x = E_Y = \frac{3}{2}k_BT$

Answer: B::D

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10. Which of the following statement(s) is (are) are correct regarding the root mean square speed (u_{rms}) and average translational kinetic energy (E_{av}) of a molecule in a gas at equilibrium?

A. u_{rms} is inversely proportional to the square root of its molecular mass.

B. E_{av} is doubled when its temperature is increased four times.

C. u_{rms} is doubled when its temperature is increased four times.

D. E_{av} at a given temperature does not depend on its molecular mass.

Answer: A::C::D

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Competition File Objective Type Questions D Multiple Choice Questions

1. The real gases show deviations from ideal gas behaviour. It is observed that real gases donot follow Boyle's law, Charles law and Avogadro law perfectly under all conditions. The deviations from ideal behaviour can be measured in terms of compressiblity factor Z.

what is meant by the term Compressiblity ? (b) What is the value of Compressibility factor for ideal gases and real gases ?

A. 1

B. 0

C. infinite

D. very very small

Answer: A

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2. Real gases do not follow the ideal gas equation perfectly under all conditions . They show deviation from the ideal behavior when

A. A

B. B

C. D

D. both A and B

Answer: D

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3. Real gases do not follow the ideal gas equation perfectly under all conditions . They show deviation from the ideal behavior when

A. A

B. C

C. D

D. both B and C

Answer: C

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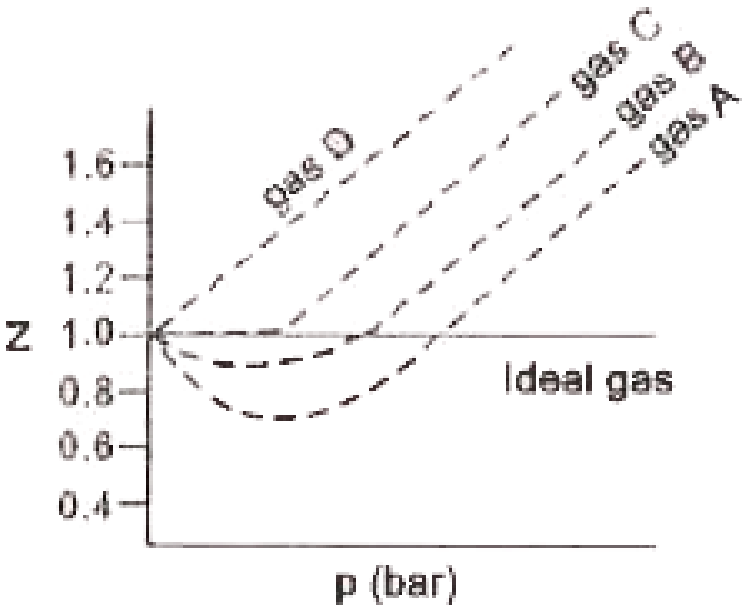
4. The real gases show deviation from ideal gases donot follow Boyle's law, Charles law and Avogadro law perfectly under all conditions. The deviations from ideal behaviour can be measured in terms of compressibility factor, Z which may be defined as :

$$Z = \frac{pV}{nRT}$$

It has been observed that Z has values greater than and less than one for

different gases. The behaviour of some common gases is shown here.



If V_o is the observed volume of a gas and V_i is the ideal gas volume, then Z is

A. $V_o - V_i$

B. V_o / V_i

C. V_i / V_o

D. $V_i - V_o$

Answer: B

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5. The real gases show deviations from ideal gas behaviour. It is observed that real gases donot follow Boyle's law, Charles law and Avogadro law perfectly under all conditions. The deviations from ideal behaviour can be measured in terms of compressiblity factor Z.

what is meant by the term Compressiblity ? (b) What is the value of Compressibility factor for ideal gases and real gases ?

A. $pV = RT - \frac{a}{V}$

B. $pV = RT$

C. $pV = RT + pb$

D. $pV = RT - pb$

Answer: C

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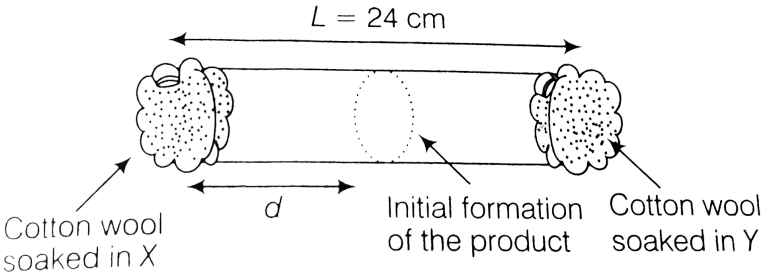
6. X and Y are two volatile liquids with molar weights of $10gmol^{-1}$ and $40gmol^{-1}$ respectively. Two cotton plugs, one soaked in X and the other soaked in Y, are simultaneously placed at the ends of a tube of length $L = 24$ cm, as shown in the figure.

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

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



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

A. 8

B. 12

C. 16

D. 20

Answer: C

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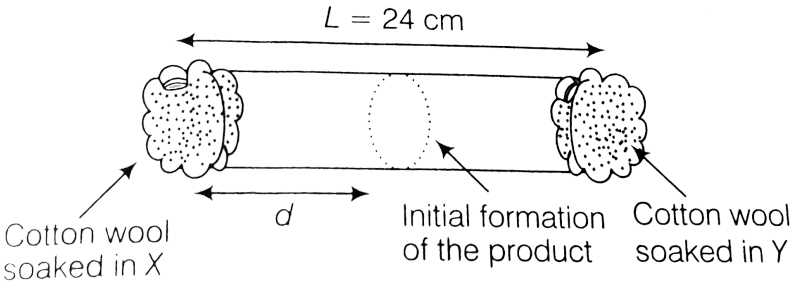
7. X and Y are two volatile liquids with molar weights of $10gmol^{-1}$ and $40gmol^{-1}$ respectively. Two cotton plugs, one soaked in X and the other soaked in Y, are simultaneously placed at the ends of a tube of length $L = 24$ cm, as shown in the figure.

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

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



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

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

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

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

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

Answer: D

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Competition File Objective Type Questions D Multiple Choice Questions Matrix Match Type Question

1. Match the gas law given in Column I with iuts description given in Column II.

Column I	Column II
(A) Charles' law	(p) $V \propto n$ (p and T constant)
(B) Boyle's law	(q) $V \propto \frac{1}{T}$ (p and n constant)
(C) Avogadro law	(r) $p_i = x_i p_{total}$ (at constant V and T)
(D) Dalton's law	(s) pV is constant (constant T and n)

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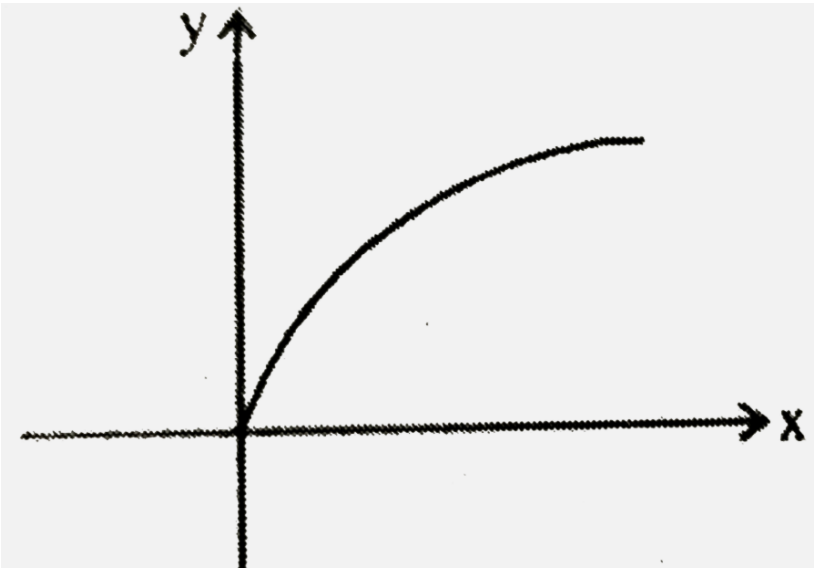
2.



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Competition File Objective Type Questions D Multiple Choice Questions Integer Type Questions

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

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2. The temperature of 4.0 mol of an ideal gas occupying $5dm^3$ at 3.32 bar $\left(R = 0.083 \text{ bar } \text{dm}^3 K^{-1} \text{mol}^{-1}\right)$ is $n \times 10K$. The value of n is

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

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5. If pressure of an ideal gas is reduced to 1/4, then volume of the gas at the same temperature will become... times.

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6. 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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7. The average speed of gas is expressed as, $\mu_{av} = \sqrt{\frac{xRT}{\pi M}}$, the value of x is

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8. If the value of Avogadro numberis $6.023 \times 10^{23} mol^{-1}$ and the vaueof Boltzmann constant is $1.380 \times 10^{-23} JK^{-1}$, then the number of significant digits in the calculated value of the universal gas constant is

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9. 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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Unit Practice Test

1. The compressibility factor for a real gas at high pressure is .

A. 1

B. $1+\frac{pb}{RT}$

C. $1+\frac{RT}{pb}$

D. $1-\frac{pb}{RT}$

Answer:

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2. An open vessel at $27^{\circ}C$ is heated untill two fifth of the air (assumed as an ideal gas) in it has escaped from the vessel. Assuming that the volume of the vessel remains constant, the temperature at which the vessel has been heated is :

A. $750^{\circ}C$

B. $500^\circ C$

C. $500K$

D. $750K$

Answer:

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3. Equal masses of methane and oxygen are mixed in an empty container at $25^\circ C$. The fraction of the total pressure exerted by oxygen is:

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

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

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

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

Answer:

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4. 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. Assertion and reason both are correct statements and reason is correct explanation for assertion.

B. Assertion and reason both are correct statements but reason is not correct explanation for assertion.

C. Assertion is correct statement but reason is wrong statement.

D. Assertion is wrong statement but reason is correct statement.

Answer:

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5. Assertion : The volume of a given mass of a gas at constant pressure is directly proportinal to its kelvin temperature.

Reason : The pressure of a fixed mass of a gas at constant volume is directly proportinal to the kelvin temperature.

A. Assertion and reason both are correct statements and reason is correct explanation for assertion.

B. Assertion and reason both are correct statements but reason is not correct explanation for assertion.

C. Assertion is correct statement but reason is wrong statement.

D. Assertion is wrong statement but reason is correct statement.

Answer:

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6. Define Dalton's law of partial pressure.

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7. What is the effect of temperature on surface tension and viscosity?

Watch Video Solution

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

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9. What are the two faulty assumptions in the kinetic molecular theory of gases which are responsible for the deviation of ideal behaviour of gases?

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10. The drain cleaner, Drainex contains small bits of aluminium which react with caustic soda to produce dihydrogen. What volume of

dihydrogen at $20^{\circ} C$ and 1 bar will be released when 0.15 g aluminium reacts?

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11. (a) How is molar mass of an ideal gas calcualted from ideal gas equation?

(b) What is the average kinetic energy of 4 g of oxygen at $-13^{\circ} C$

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12. Explain, what is meant by biofortificaiton ?

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13. (a) What is meant by compressibility factor of a gas ? Is it always equal to or greater than 1 for all gases?

(b) 1 mole of SO_2 occupies a volume of 320 mL at $27^\circ C$ and $4 \times 10^6 Pa$ pressure. Calculate the compressibility factor of the gas. $(2+3)$

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