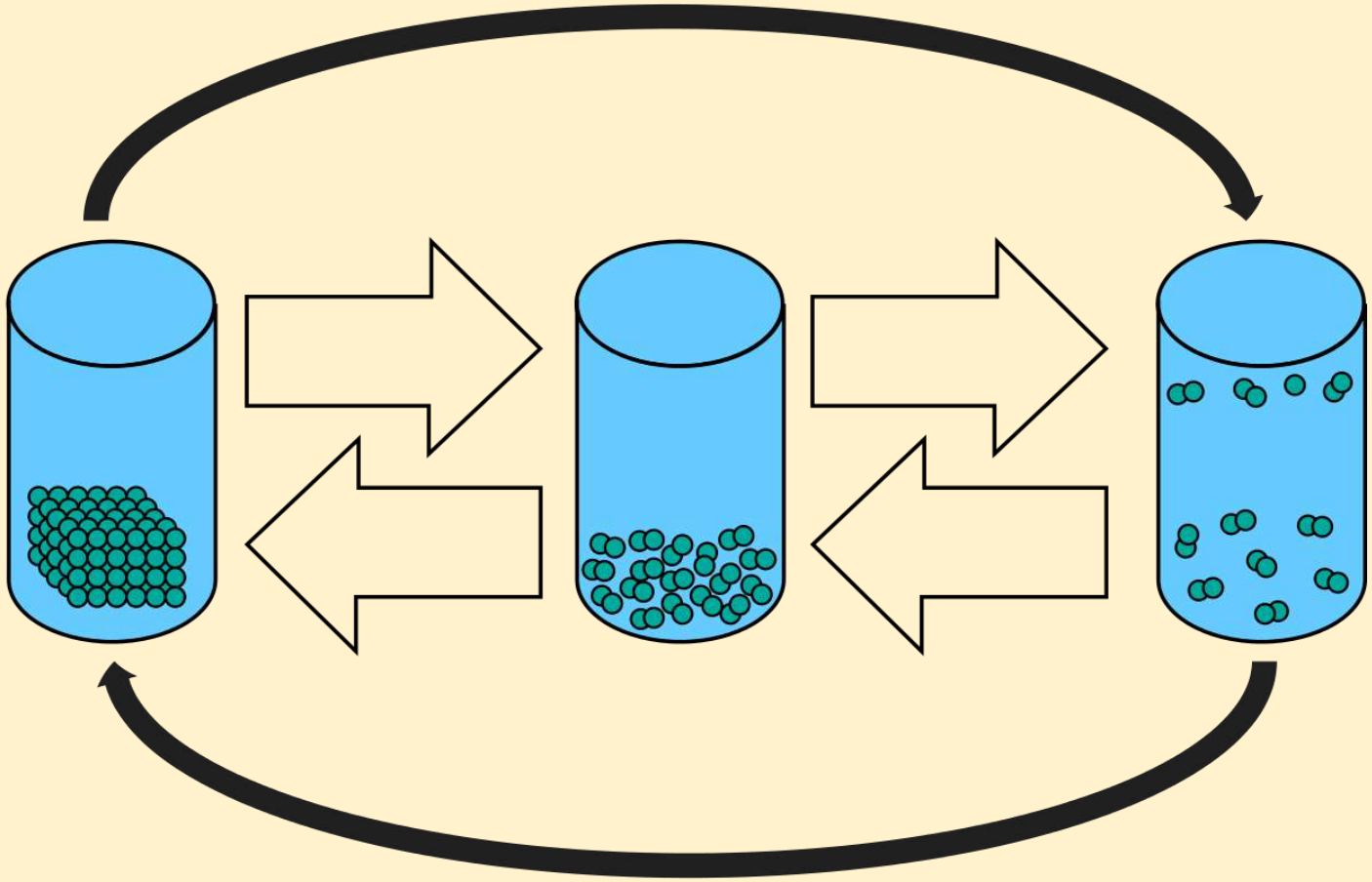
5.STATES OF MATTER



Ramanujan School of Mathematics and Physics

Theory + NCERT MCQs + Topic Wise Practice Questions + NEET PYQs

STATES OF MATTER

GASES

Intermolecular forces

LONDON DISPERSION FORCES

The weakest intermolecular forces present among non polar atom and molecules.

→ **DIPOLE-DIPOLE FORCES**

Forces act between the molecules possessing permanent dipole.

→ **DIPOLE-INDUCED DIPOLE FORCES**

The attractive forces operates between polar molecules having permanent dipole.

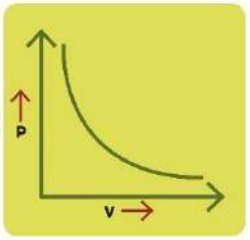
Gas Law

BOYLE'S LAW (PRESSURE-VOLUME RELATIONSHIP)

At Constant Temperature.

$\text{Volume} \propto \frac{1}{\text{Pressure}} \Rightarrow \text{Volume} \times \text{Pressure} = \text{Constant}$

i.e. $P_1V_1 = P_2V_2$ or $\frac{P_1}{P_2} = \frac{V_2}{V_1}$

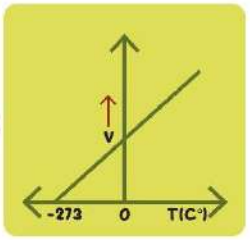


CHARLES LAW (TEMPERATURE-VOLUME RELATIONSHIP)

At Constant Pressure.

$\text{Volume} \propto \text{Temperature} \Rightarrow \frac{V}{T} = \text{Constant}$

i.e. $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ or $V_1T_2 = V_2T_2$

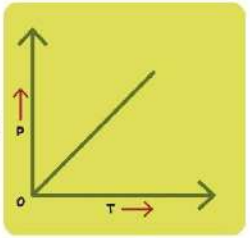


GAY LUSSAC'S LAW (PRESSURE - TEMP RELATIONSHIP)

At Constant Volume

$\text{Pressure} \propto \text{temperature} \Rightarrow \frac{P}{T} = \text{Constant}$

i.e. $\frac{P_1}{T_1} = \frac{P_2}{T_2}$ or $P_1T_2 = P_2T_1$

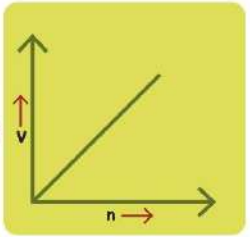


AVAGADRO LAW (VOLUME-AMOUNT RELATIONSHIP)

At Constant Pressure and temperature.

$\text{Volume} \propto \text{No. of Moles} \Rightarrow \frac{V}{N} = \text{Constant}$

i.e. $\frac{V_1}{n_1} = \frac{V_1}{n_2}$ or $V_1N_2 = V_2N_1$



IDEAL GAS EQUATION

Combining above all.

$V \propto \frac{1}{P} \times T \times n \Rightarrow PV \propto nt \Rightarrow \boxed{PV = nRT}$

Here 'R' is gas constant

$R = 8.31\ JK^{-1}mol^{-1}$

$R = 0.08\ L\ atm\ k^{-1}mol^{-1}$

$R = 2 \times 10^{-3}\ K\ cal\ K^{-1}mol^{-1}$

Physical properties

- Gases are highly compressible.
- Gases exert pressure equally in all direction.
- Gases have much lower density than liquids.
- Volume and Shapes of gases are not fixed
- They mix evenly and completely in all proportions.

Deviation from ideal gas equation (Real gases)

Real gases show deviations from ideal gas law because molecules interact with each other.

Pressure exerted the gas is lower than the pressure exerted by the ideal gas.

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

Compressibility factor (Z) $= \frac{PV}{nRT}$

Dalton's Law of Partial Pressure

Total pressure exerted by the mixture of non-reactive gases in equals to the sum of partial pressures of individual gases.

$\boxed{P_{Total} = P_1 + P_2 + P_3 \text{(At constant T, V)}}$

Kinetic-Molecular Theory of Gases

A gas contains a long no or small particles called molecules.

Size and mass of all molecules of each gas are identical

Particles of a gas are always in constant and random motion.

Particles of a gas move in all possible directions in straight line.

Collisions of gas molecules are perfectly elastic.

LIQUID

Liquification of gases

Volume of one mole of gas at critical temperature is called critical volume (V_c) and Pressure at this temperature is called critical Pressure (P_c)

Surface Tension

It the force acting per unit length perpendicular to the line drawn on the surface of liquid denoted by gamma (γ) Unit: Nm-1

Viscosity

Viscosity coefficient (η) is the force when velocity gradient is unity and the area of contact is unit area.

SI Unit: Newton Second per Square metre

$(NsM^{-2}) = Pas$ (Pascal Second)

STATES OF MATTER

Introduction

Gas is the state of matter in which molecules are always in random motion. Intermolecular interactions are extremely small (almost negligible) as compared to other states like solid and liquid. Gases are highly compressible state of matter and its state of diffusion is maximum. Gases have their own importance in living world. Air is a gaseous mixture of oxygen, nitrogen, CO2, Ar, etc.

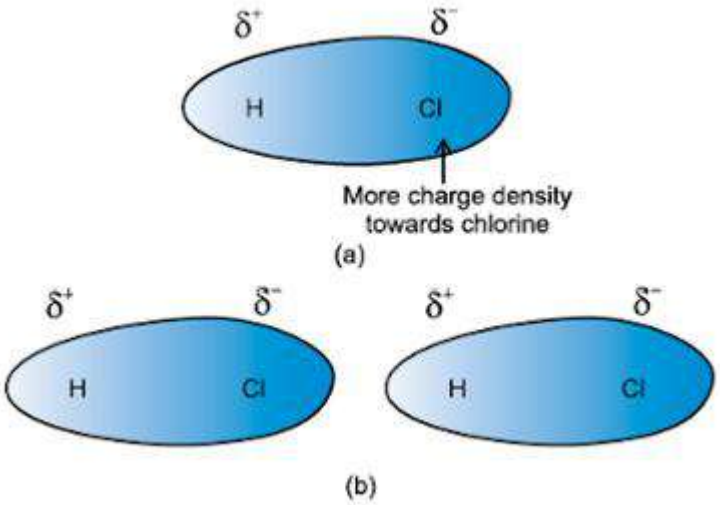
Intermolecular Forces

Intermolecular forces are the forces of attraction and repulsion between interacting particles. This term does not include the electrostatic forces that exist between the two oppositely charged ions.

Van der Waal's Forces

These are the weak forces of attraction between two molecules with or without any strong bond. These are electrostatic in nature. Types of van der Waal's forces are as follow:

1. **Dipole-dipole interaction:** These forces exist between two molecules which are polar in nature. Opposite charges of two dipoles attract each other and produce interactions called keesom forces. In HCl, dipole-dipole interactions exist.

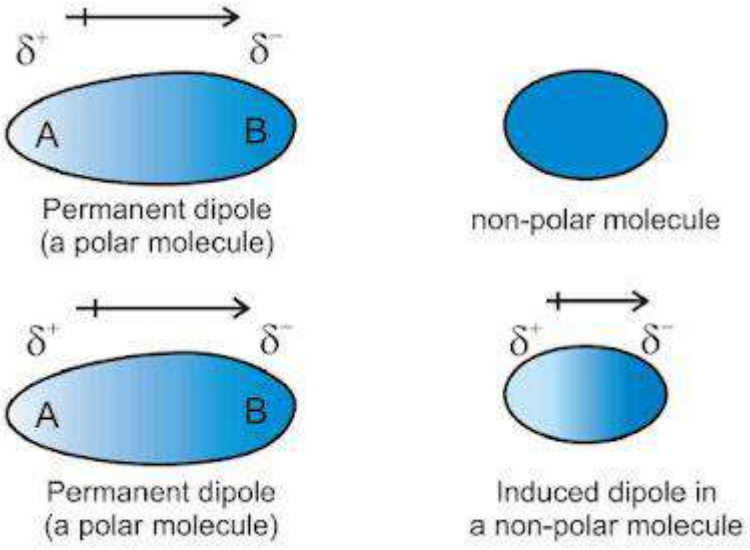


Dipole-dipole interaction energy is inversely proportional to the sixth power of the distance between the rotating polar molecules.

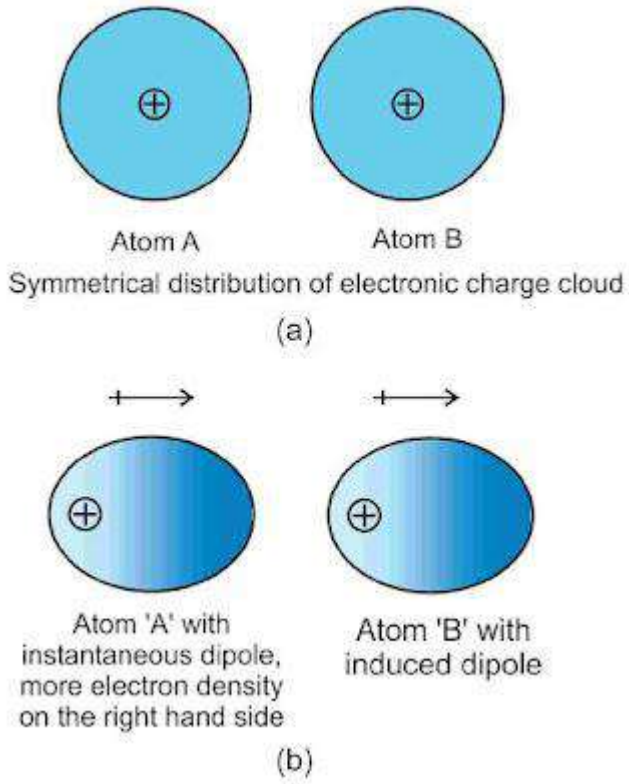
interaction energy $\propto \frac{\pi}{r^6}$

2. **Dipole-induced dipole interaction:** When a polar molecule comes closer to a non-polar molecule it induces weak polarity (dipole) in that molecule. Now,

weak interactions develop between polar molecule and molecule in which polarity is induced. These interactions are known as Debye interactions.



3. **London dispersion forces:** This polar molecule produces polarity in other molecule. Weak interaction arises between instantaneous dipoles. These interactions are known as Dispersion forces or London forces.



Measurable Properties of Gases

1. **Temperature:** Temperature is a relative measure, or indication of hotness or coldness. At absolute zero on Kelvin scale is equivalent to –273.15°C on the Celsius scale. Both the Celsius and the Kelvin scales have units of equal magnitude that is one degree celsius equivalent to one kelvin.

Thus T(K) = T(°C) + 273.15

2. **Pressure of a gas:** According to laws of motion, pressure is defined as force applied per unit area of surface. It is denoted by P and SI unit of it is pascal (Pa). It is a scalar quantity.

$$P = \frac{F}{A}$$

3. **Atmospheric Pressure:** The atmospheric pressure at a point is equal to the weight of a column of air of unit cross-sectional area extending from that point to the top of the atmosphere. Its value is 1.013×10^5 Pa at sea level. Atmospheric pressure is measured using an instrument called barometer.

Gaseous Laws

Boyle's Law (Volume-Pressure Relation)

According to this, "The volume of a given mass of gas is inversely proportional to pressure at constant temperature." This law is given by Robert Boyle.

$$P \propto \frac{1}{v} \ldots\ldots (\text{at Constant T and n})$$

$$P = k\frac{1}{v}$$

where k is the proportionality constant.

If a fixed amount of gas at constant temperature T occupying volume V_1 at pressure P_1 undergoes expansion, so that volume becomes V_2 and pressure becomes P_2, then according to Boyle's law:

$P_1V_1 = p_2V_2 = \text{constant}$

$$\frac{P_1}{P_2} = \frac{V_1}{V_2}$$

Charle's Law (Volume-Temperature Relation)

According to this, "The volume of a given mass of gas is directly proportional to its absolute temperature at constant pressure." This law is given by Jacques Charles.

$V \propto T$ ..... (at constant P)

$V = kT$

where k is the proportionality constant.

If a fixed amount of gas at constant pressure P occupying volume V_1 at temperature T_1 undergoes expansion, so that volume becomes V_2 and temperature becomes T_2, then according to Charle's Law:

$$\frac{V}{T} = \cdots \ldots \ldots . \text{constant}$$

$$\frac{V_2}{V_1} = \frac{T_2}{T_1}$$

Gay Lussac's Law (Pressure-Temperature Relation)

It states that at constant volume, the pressure of a fixed mass of a gas is directly proportional to the Kelvin temperature. The law may be expressed mathematically as

$P \propto T$ …….. (at constant V)

$P = kT$

where k is the proportionality constant.

If a fixed amount of gas at constant volume V occupying pressure P_1 at temperature T_1 undergoes expansion, so that pressure becomes P_2 and temperature becomes T_2, then according to Gay Lussac's Law:

$$\frac{P}{T} = \text{constant}$$

$$\frac{P_1}{T_1} = \frac{P_2}{P_2}$$

Avogadro's Law ((Volume - Amount Relationship)

According to this, "Equal volumes of all gases at same temperature and pressure contain equal numbers of molecules".

$V \propto n$

$V = kn$

where k is the proportionality constant.

$$\frac{V_1}{n_1} = \frac{V_2}{n_2}$$

Ideal Gas Equation

On combining the Boyle's law, Charles law and Avogadro's law we get an equation known as ideal gas equation which correlate P, V, T of a gas.

$V \propto \frac{1}{P}$ (according to Boyle's law at constant T)

$V \propto T$ (according to Charle's law at constant P)

$V \propto n$ (according to Avogadro's law at constant P and T)

$V \propto \frac{nT}{P}$

$PV \propto nT$

$PV = nRT$

Where R is proportionality constant known as universal gas constant.

Numerical value of R:

- $R = 0.0821$ litre atm K^{-1} mol^{-1}
- $R = 0.0831$ litre bar K^{-1} mol^{-1}
- $R = 8.314$ J K^{-1} mol^{-1}
- $R = 1.987 \approx 2$ cal K^{-1} mol^{-1}
- $R = 8.314 \times 107$ erg K^{-1} mol^{-1}

If temperature, volume and pressure of a fixed amount of gas vary from T_1, V_1 and p_1 to T_2, V_2 and p_2 then we can write

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

This equation is also known as Combined gas law.

Dalton's Law of Partial Pressure

Dalton's law of partial pressure and states that "the total pressure exerted by a mixture of non reacting gases is equal to the sum of partial pressure of each gas present in the mixture".

Total = $p_1 + p_2 + p_3 +$.....(at constant T, V)

Kinetic Theory of Gases

The postulates of kinetic theory of gases are as follows:

1. The gaseous molecules are considered to be point masses.
2. The volume of a molecule is negligible as compared to total volume of the gas.

3. The molecules neither attract nor repel each other.
4. The collisions are perfectly elastic i.e. there is no loss of energy during the molecular collisions.
5. The average kinetic energy of molecules is directly proportional to the absolute temperature of the gas.
6. The effect of gravity on molecular motion is negligible.

The Kinetic Gas Equation

where P =Pressure of the gas

$PV = \frac{1}{3}mv^2$

V = Volume of the gas

m = Mass of one molecule of a gas

n = number of molecules of gas

u = root mean square speed of the molecule

m × n = M = molecular weight of the gas.

$PV = \frac{1}{3}Mu^2$

Graham's Law of Diffusion

According to Graham's Law "at constant pressure and temperature, the rate of diffusion or effusion of a gas is inversely proportional to the square root of its vapour density or molecular mass".

$$r \propto \sqrt{\frac{1}{d}}$$

Behaviour of Real gases

Ideal gas: A gas which obeys the gas laws and the gas equation PV = nRT strictly at all temperatures and pressures is said to be an ideal gas. But actually the concept of ideal gas is hypothetical as there is no gas which practically is ideal. So, the non-ideal gases are the real gases which are the actually existing gases which obey gas equation approximately only under two conditions.

(i) Low pressure.

(ii) High temperature.

Causes of Deviation

There are two hypothetical postulates in the kinetic theory of gases. These are as follows:

1. The volume of a molecule is negligible as compared to total volume of the gas. Actually, gas molecules do possess some volume which account for the deviation.

2. There is no intermolecular forces of attraction between gaseous molecules.

By correcting these two postulates, we get an equation which can be applied to the gases which deviate from ideal behaviour. This deviation of a gas from ideal behaviour can also be expressed in terms of compressiblity factor (Z).

$$Z = \frac{PV}{RT}$$

Van der Waal's Equation

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

Where a and b are van der waal's constant.

Liquifaction of Gases

Gases can be liquefied by applying high pressure or by cooling.

Critical Temperature: It is the temperature above which gas cannot be liquefied, no matter how high be pressure.

$$T_c = \frac{8a}{27Rb}$$

Critical Pressure: It is the minimum pressure that is required to liquefy a gas at critical temperature.

$$P_c = \frac{a}{27b^2}$$

Critical Volume: It is the volume occupied by gas at critical temperature and critical pressure.

Vc = 3b

1. **Liquid State:**

It is the intermediate state between gaseous and solid states. Liquids possess fluidity like gases but incompressibility like solids.

Properties of liquid are:

a. A liquid is made up of molecules. Only Hg(l) is in atomic state.
b. The intermolecular forces of attraction in a liquid are quite large.
c. Liquids have no definite shape but have definite volume as the cohesive forces are strong.
d. Liquids diffuses slowly in comparison to gas.
e. They have definite volume but irregular shapes or we can say that they can take the shape of the container.

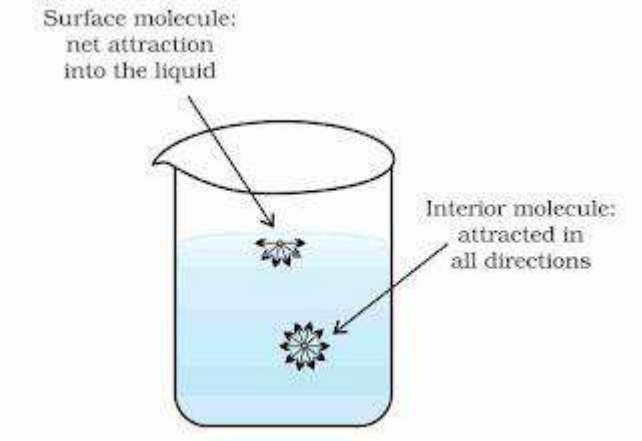
2. **Evaporation:** The process of change of liquid into vapour state at any given temperature is evaporation. Evaporation is accompanied by cooling as average kinetic energy of remaining molecules decreases. Example: Ether evaporates faster than alcohol.

3. **Vapour Pressure:** In a closed vessel when the rate of evaporation become equal to rate of condensation, i.e. equilibrium is established, the pressure exerted by the vapours of liquid on its on surface is known as vapour pressure.

4. **Boiling Point:** Boiling point of the liquid is the temperature at which the vapour pressure of the liquid is equal to the atmospheric pressure. Ex- Boiling point of pure water is 100 ℃.

5. **Surface tension:** "It is the force acting on the surface at right angles to any line of unit length". The property of surface tension may also be described in terms of the tendency of a liquid to decrease its surface area. It's SI unit is N/m.

   Surface tension, $S = \frac{F}{l}$



6. **Viscosity:** The property of the liquids which determines their resistance to flow, is called viscosity. The forces between the layers which oppose the relative motion between them are known as the forces of viscosity. Thus viscosity may be thought of as the internal function of a fluid in motion.

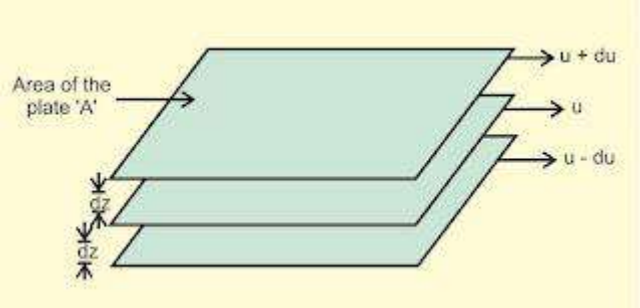
   $F \propto \frac{dv}{dz}$ is called velocity gradient]

   $F \propto A$

$$F = nA\frac{dv}{dz}$$

η is the coefficient of viscosity. It is expressed in $Nm^{-2}s$ or poise

1 poise = 0.1 $Nm^{-2}s$



7. **Fluidity(Φ):** The reciprocal of the coefficient of viscosity is called Fluidity.

$$\Phi = \frac{1}{\eta}$$

1. **Three different states of matter (solid, liquid and gas):** Solid is that state of matter which has a definite shape and a definite volume, liquid has a definite volume but no definite shape whereas gas has neither definite shape nor definite volume.

2. **Two more states of matter:**

   i. Plasma state which consists of a mixture of electrons and positively charged ions formed due to super heating of gases, e.g., in sun or stars.

   ii. Super cooled solid state in which atoms lose their identity to form a single super atom.

3. **Triple point:** It is the temperature at which all the three states of matter or phases of the same substance exist together, e.g., ice, water and water vapour exist together at 0.01°C (273.16 K) and 4.58 mm pressure.

4. **Ideal and Real gases:** A gas which obeys ideal gas equation under all conditions of temperature and pressure is called an ideal gas. However, the concept of ideal gas is only hypothetical. The gases obey gas laws only if pressure is low or temperature is high. Such gases are called real gases.

5. **Significance of van der Waal's constants:** 'a' is a measure of the magnitude of attractive forces whereas 'b' is a measure of the effective size of the gas molecules. b = 4v where v is actual volume of gas molecules. 'b' is called excluded volume or co-volume.

6. **Boiling point:** It is the temperature at which vapour pressure of the liquid becomes equal to external pressure. When external pressure = 1 atm = 760 mm, it is called normal boiling point.

7. **Surface tension of liquids:** It is the force acting at right angles to the surface along one centimeter length of the surface. Its units are dynes cm–1 or Nm–1.

8. **Vapour pressure of a liquid:** It is the pressure exerted by the vapour present in equilibrium with a liquid in a closed vessel at a particular temperature. Cooling is caused by evaporation because more energetic molecules leave the liquid.

9. **Viscosity of liquids:** It is the internal resistance of a liquid to flow or it is the force of friction which one part of the liquid offers to another part of the liquid.

10. **Factors affecting viscosity:**

    i. **Nature of the liquid :** Greater the inter-molecular forces, higher is the viscosity.

    ii. **Temperature:** Viscosity of a liquid decreases with increase of temperature because kinetic energy increases and hence inter-molecular forces of attraction decrease.

11. **Boyle's law:** Temperature remaining constant, volume of a given mass of a gas is inversely proportional to its pressure, i.e., $V \propto \frac{1}{P}$ at constant T or PV = constant.

12. **Dalton's law of partial pressures:** If two or more gases which do not react chemically with each other are enclosed in a vessel, then total pressure exerted by the gaseous mixture is the sum of their partial pressure.

13. **Graham's law of diffusion/effusion:** Under similar conditions of temperature and pressure, rates of diffusion/effusion of different gases are inversely proportional to the square root of their densities.

14. **Compressibility factor (Z):** The extent of deviation of a real gas from ideal behaviour is expressed in terms of compressibility factor (Z) viz. $Z = P\frac{V}{n}RT$.

NCERT LINE BY LINE QUESTIONS

(1.) One mole of oxygen at 273 K and one mole of SO_2 at 546 K are taken in two separate containers, then **[Page: 144]**

(a.) K.E. of 0_2 > K.E. of SO_2

(b.) K.E. of O_2 < of SO_2

(c.) K.E. of both are equal

(d.) None of the above

(2.) A real gas most closely approaches the behaviour of an ideal gas at **[Page: 147]**

(a.) 15 atm and 200 K

(b.) 1 atm and 273 K

(c.) 0.5 atm and 500 K

(d.) 15 atm and 500 K

(3.) A certain gas takes three times as long to effuse out as helium. Its molecular mass will be **[Page: 136]**

(a.) $27 g\,mol^{-1}$

(b.) $36 g\ mol^{-1}$

(c.) $6 g\ mol^{-1}$

(d.) $9 g\ mol^{-1}$

(4.) A gas at high temperature is cooled. **[Page: l53]** The highest temperature at which liquefaction of gas first occurs is called

(a.) Critical Temperature.

(b.) Boyles Temperature.

(c.) Inversion Temperature.

(d.) None of these.

(5.) In an ideal gas equation which is constant? **[JIPMER-2019, Page: 145]**

(a.) Temperature

(b.) Pressure

(c.) Volume

(d.) Universal *g*as constant

(6.) The statement that is not correct is **[Pages: 153-154]**

(a.) Compressibility factor measures the deviation of real gas from ideal behaviour.

(b.) Van der Waals constant 'a' measures extent of intermolecular attractive forces for real gases,

(c.) Critical temperature is the lowest temperature at which liquefaction of a *g*as first occurs.

(d.) Boyle point depends on the nature of rear gas.

(7.) Based on kinetic theory of gases following laws can be proved: **[Page: l45]**

(a.) Boyle's Law

(b.) Charles Law

(c.) Avogadro'slaw

(d.) All of these

(8.) At low pressure, the Van der Waals equation is reduced to **[Page: l53]**

(a.) $z = \frac{PV_m}{RT} = 1 - \frac{aP}{RT}$

(b.) $z = \frac{PV_m}{RT} = 1 + \frac{b}{RT}P$

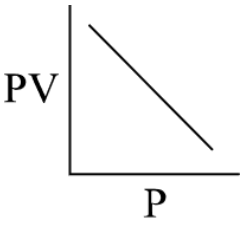
(c.) $PV_m = RT$

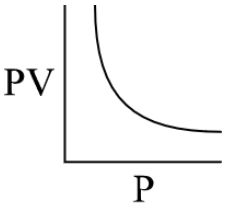
(d.) $z = \frac{PV_m}{RT} = 1 - \frac{a}{RT}$

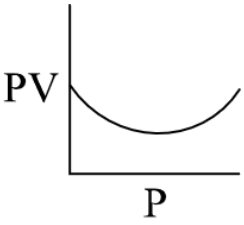
(9.) A gas deviates from ideal behaviour at a high pressure because its molecules **[Page: 147]**

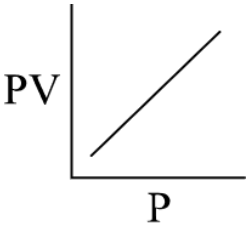
(a.) have kinetic energy
(b.) are bound by covalent bonds
(c.) attract one-another
(d.) show the Tyndall effect

(10.) Which of the following is a Boyle's plot at very low pressure? **[Page: l41]**

(a.) 

(b.) 

(c.) 

(d.) 

(11.) Different gases at the same temperature must have **[Page: 145]**

(a.) same volume.
(b.) same pressure.
(c.) same average KE.
(d.) same Van der Waals constant.

Practice Questions Framed from NCERT Text

(12.) Which one of the following statements is not correct about the effect of an increase in temperature of the distribution of molecular speeds in a gas **[Page: l44]**

(a.) The area under the distribution curve remains the same as under the lower temperature.
(b.) The distribution becomes broader.
(c.) The fraction of the molecules with the most probable speed increases.
(d.) The most probable speed increases.

(13.) Dimension of universal gas constant *R* is

(a.) $\left[VPT^{-1}n^{-1}\right]$
(b.) $\left[VP^{-1}Tn^{-1}\right]$
(c.) $\left[VPTn^{-1}\right]$
(d.) $\left[VPT^{-1}n\right]$

(14.) The temperature at which a real gas obeys ideal gas law over an appreciable range of pressure is called **[Pages: 147-149]**

(a.) Critical point.
(b.) Boyle point.
(c.) Melting point.
(d.) None of these.

(15.) If the pressure at the triple point of a substance is greater than 1 atm, we expect: **[Page: l54]**

(a.) The B.P. of the liquid to be lower than triple point temperatures.
(b.) That the substance cannot exist as a liquid.
(c.) The solid sublimes without melting.
(d.) The melting point of the solid to be at a lower temperature than the triple point temperature.

(16.) The root mean square velocity of a gas is doubled when the temperature is **[Page: 144]**

(a.) Reduced to half
(b.) Reduced to one-fourth

(c.) Increased four times

(d.) Increased two times

(17.) For 1 mole of gas, the average K.E. is given as E. The u_{rms} of gas is: **[Page: l44]**

(a.) $\left[\frac{2E}{M}\right]^{\frac{1}{2}}$

(b.) $\left[\frac{3E}{M}\right]^{\frac{1}{2}}$

(c.) $\left[\frac{2E}{3M}\right]^{\frac{1}{2}}$

(d.) $\left[\frac{3B}{2M}\right]^{\frac{1}{2}}$

(18.) The gas equation $PV = nZRT$ becomes ideal gas equation when **[Page: 146]**

(a.) $Z = 0$

(b.) $Z = 0.5$

(c.) $Z = 1$

(d.) $Z = 2$

(19.) **Assertion (A):** At 300 K, kinetic energy of 16 g of methane is equal to the kinetic energy of 32 *g* of oxygen.
Reason (R): At constant temperature, the kinetic energy of one mole of all gases is equal. **[Page: 139]**

(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.) Both A and R are false.

(20.) Which one of the following options is/are correct? **[QR code, Page: 134]**

(a.) Intermolecular forces tend to keep the molecules together.

(b.) Thermal energy of the molecules tends to keep them apart.

(c.) Both of the above

(d.) None of the above

(21.) Which factors do not affect the vapour pressure of a liquid at equilibrium?
I. Intermolecular forces of attraction
II. The volume of liquid present
III. The temperature of the liquid

(a.) Only I

(b.) Only II

(c.) I and II

(d.) II and III

(22.) The volume occupied by 1.8 *g* of water vapour at $374^{\circ}C$ and 1 bar pressure will be **[Use $R = 0.083$ bar $LK^{-1}mol^{-1}$] [odisha, NEET-2019, Pages: 145, 154]**

(a.) 96.66 L

(b.) 55.87 L

(c.) 3.10 L

(d.) 5.37 L

(23.) **Assertion (A):** If H_2 and Cl_2 closed separately in the same vessel exert pressure of 100 and 200 mm respectively. Their mixture in the same vessel at the same temperature will exert a pressure of 300 mm.
Reason (R): Dalton's law of partial pressures states that total pressure is the sum of partial pressures. **[Pages: 151-154]**

(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.) Both A and R are false.

(24.) All three states, H_2O, i.e. the triple point for H_2O or the equilibrium ice⇌water⇌vapour, exist at: **[Page: 154]**

(a.) 3.85 mm and $0.09^{\circ}C$ (b.) 4.58 mm and $0.0098^{o}C$

(c.) 760 mm and $0^{\circ}C$ (d.) None of these.

(25.) *A* and *B* are ideal gases. The molecular weights of *A* and *B* are in the ratio of 1:4. The pressure of a gas mixture containing equal weights of *A* and *B* is *P* atm. What is the partial pressure (in atm) of *B* in the mixture ? **[Page: 142]**

(a.) *P*/5 (b.) *P*/2

(c.) *P*/2.5 (d.) 3*P*/4

(26.) Molecular attraction and size of the molecules in a gas are negligible at: **[Pages: l46-l47]**

(a.) Critical point. (b.) High pressure.

(c.) High temperature and low pressure. (d.) Low temperature and high pressure.

(27.) As the temperature is raised from $20^{o}C$ to $40^{o}C$, the average kinetic energy of neon atoms changes by a factor: **[Page: 145]**

(a.) 2 (b.) $\sqrt{\frac{313}{293}}$

(c.) $\frac{313}{293}$ (d.) $\frac{1}{2}$

(28.) When the temperature of an ideal gas is increased from $27^{\circ}C$ to $927^{o}C$, the kinetic energy will be **[Page: 145]**

(a.) Same (b.) Twice

(c.) Four times (d.) Eight times

(29.) At any particular time different particles of the gas have: **[Page: 144]**

(a.) Different speeds (b.) Different kinetic energies

(c.) Different speeds and diff. kinetic energies (d.) Different kinetic energy

(30.) If the pressure and the absolute temperature of a given mass of gas are doubled, the new volume will be of the initial volume. **[Page: 141]**

(a.) Double (b.) Half

(c.) Triple (d.) Same

(31.) If a gas expands at constant temperature, it indicates that **[Page: l44]**

(a.) Kinetic energy of molecules remains the same. (b.) Number of molecules of gas increases.

(c.) Kinetic energy of molecules decreases. (d.) Pressure of the gas increases.

(32.) The Van der Waals gas may behave ideally when **[Pages: 146-147]**

(a.) the volume is very low. (b.) the temperature is very high.

(c.) the pressure is very low.

(d.) the temperature, pressure and volume all are very high.

(33.) Small droplets of a liquid are usually more spherical in shape than larger drops of the same liquid because **[Page: l53]**

(a.) force of surface tension is equal and opposite to the force of gravity.

(b.) force of surface tension predominates the force of gravity.

(c.) force of gravity predominates the force of tension.

(d.) force of gravity and force of surface tension act in the same direction.

(34.) The rms speed of hydrogen is $\sqrt{7}$ times the rms speed of nitrogen. It *T* is the temperature of the gas, then: [Page: 144]

(a.) $TH_2 = TN_2$

(b.) $7H_2 > TN_2$

(c.) $TH_2 < TN_2$

(d.) $TH_2 = \sqrt{7}\ TN_2$

(35.) **Assertion (A):** In a pressure cooker the water is brought to boil. The cooker is then removed from the stove, now on removing the lid of the pressure cooker, the water starts boiling again. **Reason (R):** The impurities in water bring down its boiling point. **[pages: 151-154]**

(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 nor the correct explanation of A.

(c.) A is true but R is false.

(d.) Both A and R are false.

(36.) **Assertion (A):** Critical temperature of CO_2 is 304 K, it cannot be liquefied above 304 K.

Reason (R): At a certain temperature, $\text{Volume} \propto \frac{1}{\text{Pressure}}$ **[Pages: 151-154]**

(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.) Both A and R are false.

(37.) The compression factor (compressibility factors for 1 mole of van der Waals *g*as at $0^{\circ}C$ and 100 atmospheric pressure) tends to be 0.5. Assuming that the volume of a gas molecule is negligible, calculate the Van der Waals constant a $\left(L^2 mol^{-2} atm\right)$ **[Page: 147]**

(a.) 12.53

(b.) 1.253

(c.) 5.75

(d.) 11.68

(38.) 100 ml O_2 and H_2 are kept at same temperature and pressure. What is true about their number of molecules)

(a.) $NO_2 > NH_2$

(b.) $NO_2 < NH_2$

(c.) $NO_2 = NH_2$

(d.) $NO_2 + NH_2 = 1$ mole

(39.) A gas can be liquefied at temperature *T* and pressure *P* provided **[Page: l54]**

(a.) $T = T_c$ and $P < Pc$

(b.) $T < T_c$ and $P > Pc$

(c.) $T > T_c$ and $P > Pc$

(d.) $T > T_c$ and $P < Pc$

(40.) 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 of the wall.

(c.) The molecules are perfectly elastic.

(d.) The molecular collisions are elastic.

(41.) The compressibility factor(s) of one mole of a van der Waals gas of negligible t*a*' value is **[Page: l50]**

(a.) 1

(b.) $\frac{bp}{RT}$

(c.) $1+\frac{bp}{RT}$

(d.) $1-\frac{bp}{RT}$

(42.) In kinetic theory it is assumed that average kinetic energy of the gas molecules is: **[Page: I44]**

(a.) Directly proportional to the absolute temperature.

(b.) Inversely proportional to the temperature.

(c.) Directly by proportional to the pressure.

(d.) Inversely proportional to the pressure.

(43.) Dipole-induced-dipole interactions are present in which of the following pairs ? . **[Page: l34]**

(a.) HCl and He atoms

(b.) S_1F_4 and He atoms

(c.) H_2O and alcohol

(d.) Cl_2 and CCl_4

(44.) The Van der Waals constant '*a*' for different gases have been given as **[Page: 146]**
The gas that can be most easily liquefied

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

(a.) O_2 (b.) N_2 (c.) $-CH_4$ (d.) NH_3

(45.) Dalton's law of partial pressure is not applicable to **[Page: 137]**

(a.) O_2+O_3

(b.) $CO+CO_2$

(c.) NH_3+HCl

(d.) $I+O_2$

(46.) The interaction between a polar and non-polar molecule is known as **[QR code, Page: 134]**

(a.) Dipole-induced-dipole interaction

(b.) Dipole-dipole interaction

(c.) Ion-dipole interaction

(d.) None of the above

(47.) If saturated vapours are compressed slowly (temperature remaining constant) to half the initial volume, the vapour pressure will: **[Page: 154]**

(a.) Becomes 4 turns.

(b.) Become doubled.

(c.) Remain unchanged.

(d.) Become half.

(48.) Vapours of a liquid exist only: **[Page: l55]**

(a.) Below B.P.

(b.) Below critical temperature.

(c.) Below inversion temperature.

(d.) Above critical temperature.

(49.) The behaviour of real gas approaches ideal behaviour at **[Page: 146]**

(a.) low temperature, low pressure.

(b.) high temperature, high pressure.

(c.) low temperature, high pressure.

(d.) high temperature, low pressure.

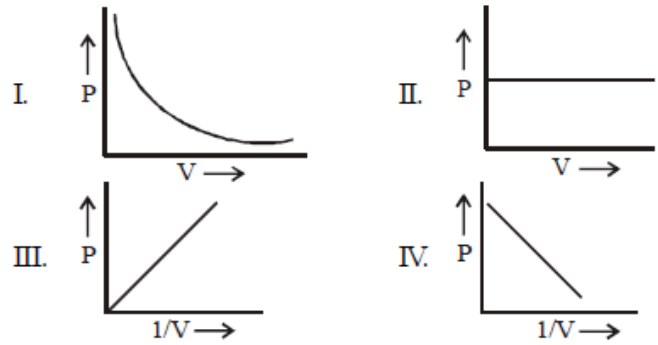
(50.) A gaseous mixture contains 56 g of N_2, 44g of CO_2, and 16 g of CH_4. The total pressure of the mixture is 720 mmHg. The partial pressure of CH_4 is **[Page: 141]**

(a.) 180 mm (b.) 360 mm
(c.) 540 mm (d.) 720 mm

TOPIC WISE PRACTICE QUESTIONS

TOPIC 1: Intermolecular Forces, Gas Laws and Ideal Gas Equation

1. Which of the following is not a type of van der Waal's forces?
(a) Dipole - dipole forces (b) Dipole - induced dipole forces
(c) Ion - dipole forces (d) London forces
2. Gas equation PV = nRT is obeyed by
(a) only isothermal process (b) only adiabatic process (c) both (a) and (b) (d) none of these
3. Air at sea level is dense. This is a practical application of
(a) Boyle's law (b) Charle's law (c) Kelvin's law (d) Brown's law
4. "Equal volumes of all gases at the same temperature and pressure contain equal number of particles." This statement is a direct consequence of :
(a) Perfect gas law (b) Avogadro's law (c) Charle's law (d) Boyle's law
5. A gas in an open container is heated from 27 °C to 127 °C. The fraction of the original amount of the gas remaining in the container will be
(a) 3/4 (b) 1/2 (c) 1/4 (d) 1/8
6. The pressure exerted by 6.0g of methane gas in a 0.03 m3 vessel at 129°C is (Atomic masses : C = 12.01, H = 1.01 and R = 8.314 JK^{-1} mol^{-1})
(a) 31684 Pa (b) 215216 Pa (c) 13409 Pa (d) 41648 Pa
7. Two flasks A and B of 500 mL each are respectively filled with O_2 and SO_2 at 300 K and 1 atm pressure. The flasks will contain
(a) the same number of atoms (b) the same number of molecules
(c) more number of moles of molecules in flask A as compared to flask B
(d) the same amount of gases
8. Dalton's law of partial pressure will not apply to which of the following mixture of gases
(a) H_2 and SO_2 (b) H_2 and Cl_2 (c) H_2 and CO_2 (d) CO_2 and Cl_2
9. Dipole-induced dipole interactions are present in which of the following pairs :
(a) Cl_2 and CCl_4 (b) HCl and He atoms (c) SiF_4 and He atoms (d) H_2O and alcohol
10. The pressure of sodium vapour in a 1.0 L container is 10 torr at 1000 °C. How many atoms are in the container?
(a) 9.7×10^{17} (b) 7.6×10^{19} (c) 4.2×10^{17} (d) 9.7×10^{19}
11. The atmospheric pressure on Mars is 0.61 kPa. What is the pressure in mm Hg?
(a) 0.63 (b) 4.6 (c) 6.3 (d) 3.2
12. 56 g of nitrogen and 96 g of oxygen are mixed isothermaly and at a total pressure of 10 atm. The partial pressures of oxygen and nitrogen (in atm) are respectively:
(a) 4, 6 (b) 5, 5 (c) 2, 8 (d) 6, 4
13. What is the ratio of diffusion rate of oxygen to hydrogen?
(a) 1 : 4 (b) 4 : 1 (c) 1 : 8 (d) 8 : 1
14. Which of following graph(s) represents Boyle's law



(a) Only I (b) II and IV (c) I and III (d) Only III

15. Pressure remaining the same, the volume of a given mass of an ideal gas increases for every degree centigrade rise in temperature by definite fraction of its volume at
(a) 0 °C (b) its critical temperature (c) absolute zero (d) its Boyle's temperature

16. The ratio of the rate of diffusion of helium and methane under identical condition of pressure and temperature will be
(a) 4 (b) 2 (c) 1 (d) 0.5

17. A gas diffuses 1/5 times as fast as hydrogen. Its molecular weight is
(a) 50 (b) 25 (c) 25 $\sqrt{2}$ (d) 50 $\sqrt{2}$

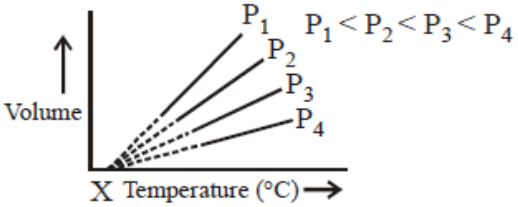
18. Which of the following are arranged in the correct order?
I. Gas > Liquid > Solid (Thermal energy)
II. Solid > Liquid > Gas (Intermolecular force)
Select the correct option.
(a) I only (b) II only (c) Both I and II (d) None of these

19. At N.T.P the volume of a gas is found to be 273 mL. What will be the volume of this gas at 600 mm of Hg and 273°C?
(a) 391.8 mL (b) 380 mL (c) 691.6 mL (d) 750 Ml

20. If three unreactive gases having partial pressures P_A, P_B and P_C and their moles are 1, 2 and 3 respectively then their total pressure will be
(a) $P = P_A + P_B + P_C$ (b) $P = \frac{P_A + P_B + P_C}{6}$ (c) $P = \frac{\sqrt{P_A + P_B + P_C}}{3}$ (d) None of these

21. For 1 mol of an ideal gas at a constant temperature T, the plot of (log P) against (log V) is a (P : Pressure, V : Volume)
(a) Straight line parallel to x-axis. (b) Straight line with a negative slope.
(c) Curve starting at origin. (d) Straight line passing through origin.

22. What is the value of X in °C for given volume vs temperature curve ?



(a) 0° C (b) 273.15° C (c) – 273.15° C (d) 300° C

23. 4.4 g of a gas at STP occupies a volume of 2.24 L, the gas can be
(a) O_2 (b) CO (c) NO_2 (d) CO_2

24. A certain gas takes three times as long to effuse out as helium. Its molecular mass will be :
(a) 27 u (b) 36 u (c) 64 u (d) 9 u

25. The correct value of the gas constant 'R' is close to :
(a) 0.082 litre-atmosphere K (b) 0.082 litre-atmosphere K^{-1} mol^{-1}

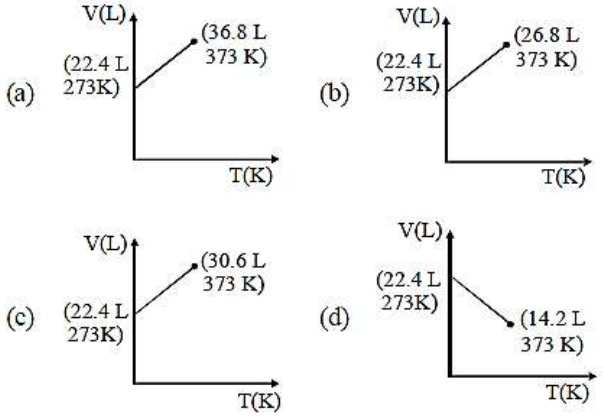
(c) 0.082 litre – atmosphere^{-1} K mol^{-1} (d) 0.082 litre –1 atmosphere^{-1} K mol

26. 500 mL of air at 760 mm pressure were compressed to 200 mL. If the temperature remains constant, what will be the pressure after compression?
(a) 1800 mm (b) 1900 mm (c) 2000 mm (d) 1500 mm

27. At a pressure of 760 torr and temperature of 273.15 K, the indicated volume of which system is not consistent with the observation
(a) 14 g of N_2 + 16 g of O_2 ; Volume = 22.4 L
(b) 4 g of He + 44 g of CO_2 ; Volume = 44.8 L
(c) 7 g of N_2 + 36 g of O_3 ; Volume = 22.4 L
(d) 17 g of NH_3 + 36.5 g of HCl, Volume = 44.8 L

28. One mole of gas A and three moles of a gas B are placed in flask of volume 100 litres at 27°C. Calculate the total partial pressure of the gases in the mixture.
(a) 1.0 atm. (b) 0.9 atm (c) 0.985 atm (d) 10.850 atm.

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



30. A mixture of 16 g CH_4 and 64 g of O_2 is ignited in a sealed bulb of 3L and then cooled to 27 °C. The pressure in the bulb will be
(a) 0.82 atm (b) 8.2 atm (c) 24.6 atm (d) 2.46 atm

TOPIC 2: Kinetic Theory of Gases and Molecular Speeds

31. The ratio between most probable velocity, mean velocity and r.m.s velocity is :
(a) $\sqrt{2}:\sqrt{8/\pi}:\sqrt{3}$ (b) $\sqrt{2}:\sqrt{3}:\sqrt{8/\pi}$ (c) 1 : 2 : 3 (d) $1:\sqrt{2}:\sqrt{3}$

32. As the temperature is raised from 20 °C to 40 °C, the average kinetic energy of neon atoms changes by a factor of which of the following ?
(a) $\frac{313}{293}$ (b) $\sqrt{(313/293)}$ (c) 1/2 (d) 2

33. Boyle's law, according to kinetic equation can be expressed as
(a) PV = KT (b) PV =RT (c) $PV = \frac{3}{2}kT$ (d) $PV = \frac{2}{3}kT$

34. The r.m.s velocity of CO_2 at temperature T (in kelvin) is $x$cms^{-1} . At what temperature (in kelvin) the r.m.s. velocity of nitrous oxide would be 4x cms^{-1} ?
(a) 16 T (b) 2 T (c) 4 T (d) 32 T

35. The molecular velocities of two gases at the same temperature are u_1 and u_2 and their masses are m_1 and m_2 respectively. Which of the following expressions are correct?
1) $\frac{m_1}{u_1^2} = \frac{m_2}{u_2^2}$ 2) $m_1u_1 = m_2u_2$ 3) $\frac{m_1}{u_1} = \frac{m_2}{u_2}$ 4) $m_1u_1^2 = m_2u_2^2$

36. Kinetic theory of gases proves
(a) only Boyle's law (b) only Charles' law (c) only Avogadro's law (d) All of these

37. The root mean square velocity of an ideal gas at constant pressure varies with density (d) as
(a) d^2 (b) d (c) $\sqrt{d}$ (d) $1/\sqrt{d}$

38. Which one of the following is the wrong assumption of kinetic theory of gases ?
(a) Momentum and energy always remain conserved.
(b) Pressure is the result of elastic collision of molecules with the container's wall.
(c) Molecules are separated by great distances compared to their sizes.
(d) All the molecules move in straight line between collision and with same velocity.

39. Consider three one-litre flasks labelled A, B and C filled with the gases NO NO_2, and N_2O, respectively, each at 1 atm and 273 K. In which flask do the molecules have the highest average kinetic energy?
(a) Flask C (b) All are the same (c) Flask A (d) None

40. Which of the following change is observed occurs when a substance X is converted from liquid to vapour phase at the standard boiling point?
I. Potential energy of the system decreases
II. The distance between molecules increases
III. The average kinetic energy of the molecules in both phases are equal
(a) I only (b) II only (c) III only (d) II and III only

41. If u_{rms} of a gas is 30 $R^{1/2}ms^{-1}$ at 27 °C then molar mass of gas is:
(a) 0.02 kg/mol (b) 0.001 kg/mol (c) 0.003 kg/mol (d) 1 kg/mol

42. Consider a real gas placed in a container. If the intermolecular attractions are supposed to disappear suddenly which of the following would happen?
(a) Pressure decreases (b) Pressure increases (c) Pressure remains unchanged (d) Gas collapse

43. The pressure of a real gas is less than the pressure of an ideal gas because of :
(a) increase in number of collisions (b) finite size of molecule
(c) increase in KE of molecules (d) intermolecular forces of attraction

44. At what temperature the rms velocity of SO_2 be same as that of O_2 at 303 K ?
(a) 273 K (b) 606 K (c) 303 K (d) 403 K

45. A closed flask contains water in all its three states solid, liquid and vapour at 0 °C. In this situation, the average kinetic energy of water molecules will be
(a) equal in all the three states (b) the greatest in vapour state
(c) the greatest in the liquid state (d) the greatest in the solid state

TOPIC 3: Van der Waal's Equation and Liquefaction of Gases

46. The compressibility factor for H2 and He is usually :
(a) Z > 1 (b) Z = 1 (c) Z < 1 (d) Either of these

47. It V is the volume of one molecule of gas under given conditions, the van der Waal's constant b is
(a) 4 V (b) $\frac{4V}{N_0}$ 3) $\frac{N_0}{4V}$ 4) $4VN_0$

48. The units of constant 'a' in van der Waal's equation is
(a) dm^6 atm mol^{-2} (b) dm^3 atm mol^{-1} (c) dm atm mol^{-1} (d) atm mol^{-1}

49. Maximum deviation from ideal gas is expected from :
(a) $N_2(g)$ (b) $CH_4(g)$ (c) NH_3 (g) (d) $H_2(g)$

50. At which one of the following temperature-pressure conditions the deviation of a gas from ideal behaviour is expected to be minimum?
(a) 350 K and 3 atm. (b) 550 K and 1 atm. (c) 250 K and 4 atm. (d) 450 K and 2 atm.

51. In van der Waal's equation of state for a non-ideal gas, the term that accounts for intermolecular forces is
1) $(V-b)$ 2)RT 3) $\left(P+\frac{\alpha}{V^2}\right)$ 4) $(RT)^{-1}$

52. In van der Waal's equation of state of the gas law, the constant 'b' is a measure of
(a) volume occupied by the molecules (b) intermolecular attraction
(c) intermolecular repulsions (d) intermolecular collisions per unit volume

53. Positive deviation from ideal behaviour takes place because of
(a) molecular interaction between atoms and $PV/nRT > 1$
(b) molecular interaction between atoms and $PV/nRT < 1$
(c) finite size of atoms and $PV/nRT > 1$
(d) finite size of atoms and $PV/nRT < 1$

54. The ratio of Boyle's temperature and critical temperature for a gas is :
1) $\frac{8}{27}$ 2) $\frac{27}{8}$ 3) $\frac{1}{2}$ 4) $\frac{2}{1}$

55. The compressibility factor for a real gas at high pressure is:
1) 1 2) $1+\frac{Pb}{RT}$ 3) $1-\frac{Pb}{RT}$ 4) $1+\frac{RT}{Pb}$

56. The van der Waal's constant '*a*' for four gases P, Q, R and S are 4.17, 3.59, 6.71 and 3.8 atm L^2 mol^{-2} respectively. Therefore, the ascending order of their liquefaction is
(a) R < P < S < Q (b) Q < S < R < P (c) Q < S < P < R (d) R < P < Q < S

TOPIC 4: Liquid State

57. The correct order of viscosity of the following liquids will be
(a) Water < methyl alcohol < dimethyl ether < glycerol
(b) methyl alcohol < glycerol < water < dimethyl ether
(c) dimethyl ether < methyl alcohol < water < glycerol
(d) glycerol < dimethyl ether < water < methyl alcohol

58. Which among the following has lowest surface tension ?
(a) Hexane (b) Water (c) CH_3OH (d) CH_3CH_2OH

59. The liquid which has the highest rate of evaporation is
(a) petrol (b) nail-polish remover (c) water (d) alcohol

60. A drop of oil is placed on the surface of water. Which of the following statement is correct ?
(a) It will remain on it as a sphere
(b) It will spread as a thin layer
(c) It will be partly as spherical droplets and partly as thin film
(d) It will float as a distorted drop on the water surface

NEET PREVIOUS YEARS QUESTIONS

1. The correction factor '*a*' in the ideal gas equation corresponds to **[2018]**
(a) density of the gas molecules. (b) volume of the gas molecules.
(c) forces of attraction between the gas molecules.
(d) electric field present between the gas molecules.

2. Given van der Waals constants 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? **[2018]**
(a) NH_3 (b) H_2 (c) CO_2 (d) O_2

3. 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? **[2016]**
(a) 1/8 (b) ¼ (c) 3/8 (d) 1/2

4. A mixture of gases contains H_2 and O_2 gases in the ratio of 1 : 4 (w/w). What is the molar ratio of the two gases in the mixture? **[2015]**

(a) 4 : 1 (b) 16 : 1 (c) 2 : 1 (d) 1 : 4

5. 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 about the gas and its compressibility factor (Z) is : **(2019)**

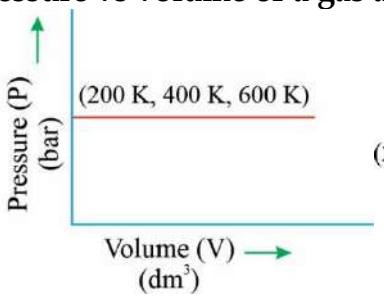
(1) Z > 1 and attractive forces are dominant
(2) Z > 1 and repulsive forces are dominant
(3) Z < 1 and attractive forces are dominant
(4) Z < 1 and repulsive forces are dominant

6. The volume occupied by 1.8 g of water vapour at 374 °C and 1 bar pressure will be :- **(2019 odissa)**
[Use R = 0.083 bar L $K^{-1}mol^{-1}$]
(1) 96.66 L (2) 55.87 L (3) 3.10 L (4) 5.37 L

7. The minimum pressure required to compress 600 dm^3 of a gas at 1 bar to 150 dm^3 at 40°C is **(2020 covid)**
(1) 4.0 bar (2) 0.2 bar (3) 1.0 bar (4) 2.5 bar

8. A mixture of N_2 and Ar gases in a cylinder contains 7g of N_2 and 8g of Ar. If the total pressure of the mixture of the gases in the cylinder is 27 bar. The partial pressure of N_2 is
[Use atomic masses (in g mol^{-1}): N = 14, Ar = 40] **(2020)**
1) 18 bar 2) 9 bar 3) 12 bar 4) 15 bar

9. Choose the correct option for graphical representation of Boyle's law, which shows a graph of pressure vs volume of a gas at different temperature: [NEET-2021]

(1)


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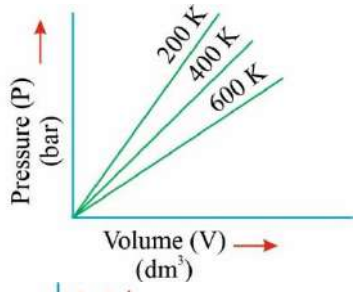

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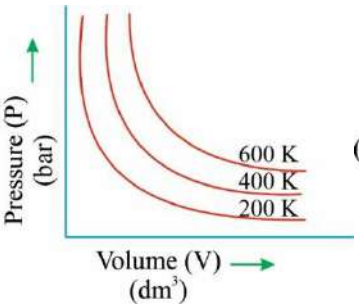
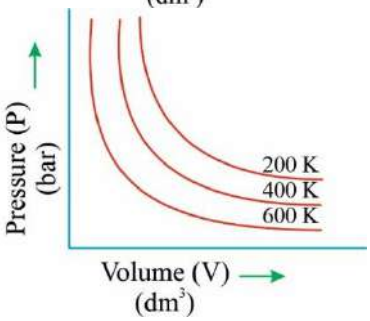


(4)


10. Choose the correct option for the total pressure (in atm). In a mixture of 4 g O_2 and 2 g H_2 confined in a total volume of one litre at $0°C$ is: $\left[Given\, R = 0.082 L\, atm\, mol^{-1}K^{-1}, T = 273K\right]$

[NEET-2021]

1) 2.602 2) 25.18 3) 26.02 4) 2.518

11. Which one is not correct mathematical equation for Dalton's Law of partial pressure? Here p = total pressure of gaseous mixture? **[NEET-2022]**

1) $p = p_1 + p_2 + p_3$

2) $p = n_1\frac{RT}{V} + n_2\frac{RT}{V} + n_3\frac{RT}{V}$

3) $p_i = X_i P$, where p_i = partial pressure of i^{th} gas X_i = mole fraction of i^{th} gas in gaseous mixture

4) $p_i = X_i P_i^o$, where X_i = mole fraction of i^{th} gas in gaseous mixture P_i^o = pressure of i^{th} gas in pure state

NCERT LINE BY LINE QUESTIONS – ANSWERS

(1.)	b	**(2.)**	c	**(3.)**	b	**(4.)**	a	**(5.)**	d
(6.)	c	**(7.)**	d	**(8.)**	a	**(9.)**	c	**(10.)**	c
(11.)	c	**(12.)**	c	**(13.)**	a	**(14.)**	b	**(15.)**	a
(16.)	c	**(17.)**	a	**(18.)**	c	**(19.)**	a	**(20.)**	c
(21.)	b	**(22.)**	d	**(23.)**	d	**(24.)**	b	**(25.)**	a
(26.)	c	**(27.)**	c	**(28.)**	c	**(29.)**	c	**(30.)**	d
(31.)	a	**(32.)**	c	**(33.)**	b	**(34.)**	c	**(35.)**	c
(36.)	b	**(37.)**	b	**(38.)**	c	**(39.)**	b	**(40.)**	c
(41.)	c	**(42.)**	a	**(43.)**	a	**(44.)**	d	**(45.)**	c
(46.)	b	**(47.)**	c	**(48.)**	c	**(49.)**	d	**(50.)**	a

TOPIC WISE PRACTICE QUESTIONS-ANSWERS

1) 3	2) 3	3) 1	4) 2	5) 1	6) 4	7) 2	8) 2	9) 2	10) 2
11) 2	12) 1	13) 1	14) 3	15) 1	16) 2	17) 1	18) 3	19) 3	20) 1
21) 2	22) 3	23) 4	24) 2	25) 2	26) 2	27) 4	28) 3	29) 3	30) 2
31) 1	32) 1	33) 4	34) 1	35) 4	36) 4	37) 4	38) 4	39) 2	40) 4
41) 4	42) 2	43) 4	44) 2	45) 2	46) 1	47) 4	48) 1	49) 3	50) 2
51) 3	52) 1	53) 3	54) 2	55) 2	56) 3	57) 3	58) 1	59) 1	60) 2

NEET PREVIOUS YEARS QUESTIONS-ANSWERS

1) 3	**2) 1**	**3) 1**	**4) 1**	**5) 3**	**6) 4**	**7) 1**	**8) 4**	**9) 3**	**10) 2**
11) 4									

NCERT LINE BY LINE QUESTIONS – SOLUTIONS

(1.) (b) $\text{K.E.} = 3/2\,RT$

$\text{K.E.} \times T$

$$= \frac{\text{K.E.O}_2}{\text{K.E.SO}_2} = \frac{\text{TO}_2}{\text{TSO}_2} = \frac{273\text{K}}{546\text{K}} = \frac{1}{2}$$

$\text{K.E.SO}_2 = \text{K.E.O}_2$

$\text{K.E.SO}_2 > \text{K.E.O}_2$

(2.) (c)

(3.) (b) According to Graham's law of diffusion

$$r \propto \frac{1}{\sqrt{d}} \propto \frac{1}{\sqrt{M}} \Rightarrow \frac{r_1}{r_2} = \sqrt{\frac{M_2}{\Lambda 4_1}}$$

$$\text{Rate of diffusion} = \frac{\text{Volume of gas diffused}(V)}{\text{Time Taken}(t)}$$

$$\frac{V_1 / t_1}{V_2 / t_2} = \sqrt{\frac{M_2}{M_1}}$$

If same volume of two gases diffuse, then

$$\frac{t_2}{t_1} = \sqrt{\frac{M_2}{M_1}} \; V_1 = V_2$$

Here $t_2 = 3t_1, M_1 = 4u, M_2 = \frac{3t_1}{t_1} = \sqrt{\frac{M_2}{M_1}} \Rightarrow 3 = \sqrt{\frac{M_2}{4}}$

$$\Rightarrow 9 = \frac{M_2}{4}$$

$$M_2 = 36u$$

(4.) (a)

(5.) (d) According to ideal gas equation, $pV = nRT$

where, p = pressure, V = volume

n = no. of mole, T = temperature

R = universal gas constant

$R = 8.314 \, Jmol^{-1}K^{-1}$

$= 0.08205 \text{ L atm mol}^{-1}K^{-1}$

$= 1.99 \text{ cal mol}^{-1}K^{-1}$

$= 5.189 \times 10^{19} eVmol^{-1}K^{-1}$.

(6.) (c) Critical temperature is the temperature above which a gas cannot be liquefied irrespective of the pressure applied.

(7.) (d) Avogadro's law is based on Kinetic theory of gases.

(8.) (a) When pressure is low tb' can be neglected thus

$$\left(P + \frac{a}{V^2}\right) V = RT$$

$$\left(PV + \frac{a}{V}\right) = RT$$

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

$$\frac{PV}{RT} = \frac{RT}{RT} - \frac{a}{VRT}$$

$$Z = 1 - \frac{a}{VRT} \left(\because Z = \frac{PV}{RT}\right)$$

$$= 1 - \frac{aP}{RT}$$

(9.) (c) Some attractive forces exist between the molecules of real gases. When a molecule approaches the wall of the container it experiences an inward pull as a result of altercative forces exerted by the neighbouring molecules inside the vessel, therefore the obsessed pressure is less than the ideal pressure and hence gas deviates from ideal behaviour at high pressure.

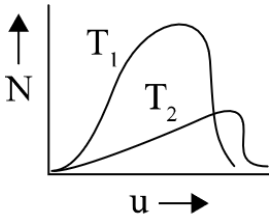
(10.) (c)

(11.) (c) K.E. $\times$ T

kinetic energy depends on temperature

Thus, same temperature means same K.E.

(12.) (c) Distribution of molecules (N) with velocity (t)) at two temperatures T_1 and $T_2 (T_2 > T_1)$ is as shown below:



At both temperatures, distribution of molecules with increase in velocity reaches a maximum value and then decreases. Thus, on increasing the temperature, the fraction of the molecules with the most probable speed increases.

(13.) (a) From the gas equation $PV = nRT$

$$R = \frac{P \times V}{n \times T} = \left(VPT^{-1}n^{-1}\right)$$

(14.) (b)

(15.) (a)

(16.) (c) $U_{rms} \times \sqrt{T}$

$$\frac{U_{rms_1}}{U_{rms_2}} = \sqrt{\frac{T_1}{T_2}}$$

$$\frac{U}{2U} = \sqrt{\frac{T_1}{T_2}}$$

$$\frac{T_1}{T_2} = \frac{1}{4}$$

$$T_2 = 4T_1$$

(17.) (a) Average $K.E.E = 3/2RT$

$$U_{rms} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{2E}{M}}$$

(18.) (c) The ideal gas equation is

$PV = nRT$

When Z (the compressibility factor) is one, the given equation $PV = nZRT$ becomes ideal gas equation.

(19.) (a) Kinetic energy for n moles of gas is given by equation.

$E = 3/2KTn$ (where $K =$ Boltzmann constant) $E \propto T$

Thus, at constant temperature kinetic energy of one mole of any gas is equal.

(20.) (c) Intermolecular forces tend to keep molecules together while thermal energy tend to keep them aparts.

(21.) (b)

(22.) (d) According to ideal gas equation

$pV = nRT$

$$\text{or } V = \frac{nRT}{p} = \frac{W}{M.wt}\frac{RT}{p} \ldots (i) \left[n = \frac{W}{M.wt} \right]$$

Given, $w = 1.8$ g, $T = 374^oC$

$= (374 + 273)\ K = 647\ K$

$p = 1$ bar, $R = 0.083\ \text{bar}\,LK^{-1}mol^{-1}$

On substituting the given values in liq. (i), we get

$$V = \frac{1.8g}{18gmol^{-1}} \times \frac{0.083barLK^{-1}mol^{-1} \times 647K}{1bar} = 5.37\ L$$

(23.) (d) H_2 and Cl_2 react equally. Hence, Dalton's law is not applicable. Dalton's law states that "At a given temperature, the total pressure exerted by two or more non-reacting gases occupying a definite volume is equal to the sum of the partial pressures of the component gases

(24.) (b)

(25.) (a) Mol wt. ratio of *A* and $B = 1:4$

Mole ratio of *A* and *B*, if equal

Weight of *A* and *B* are taken = 4: 1

Partial pressure of $B = \frac{1}{(1+4)} \times P$

$= P/5$

(26.) (c)

(27.) (c)

(28.) (c) Temperature of ideal *g*as is increased from $27^{\circ}C$ to $927^{\circ}C$.

$KE = 3/2RT$

$T_1 = 27 + 273 = 300K$

$T_2 = 927 + 273 = 1200K$

$KE_1 = 3/2 \times R \times 300\ K$

$KE_2 = 3/2 \times R \times 1200K$

So, $\frac{KE_2}{KE_1} = \frac{3/2 \times R \times 1200K}{3/2 \times R \times 300K} = 4$

(29.) (c) At any particular time, different particles of the gas have different speed and different K.E.

(30.) (d) $V \propto T$

$$V \propto \frac{1}{P}$$

So when pressure is doubled volume gets halved and when temperature is doubled the volume gets doubled, so when both pressure and absolute temperature are doubled the new will be the same as before.

(31.) (a) The average translational K.E. of one molecule of an ideal gas will be given by

$$\bar{E}K = \frac{K.E}{N_A} = \frac{3/2RT}{N_A} = 3/2KT.$$

where $R/N_A = K$ (Boltzmann Constant)

i.e. $= EK \times T$

So at constant temperature K.E. of molecules remains the same.

(32.) (c) van der Waals' gas may behave ideally when pressure is very low as compressibility factor (*z*) approaches 1.

At high temperature $z > 1$.

(33.) (b)

(34.) (c) $U_{rms}(H_2) = \sqrt{7}U_{rms}(N_2)$

or $\sqrt{\frac{3RTH_2}{2}} = \sqrt{7} \times \sqrt{\frac{3RTN_2}{28}}$

$TN_2 = 2TH_2$

or $7N_2 > TH_2$

(35.) (c) In pressure cooker, water boils above $100^{o}C$. When the lid of cooker is opened, pressure is lowered so that boiling point decreases and water boils again. The impurities in water increases its boiling point.

(36.) (b) Critical temperature of a gas may be defined as that temperature above which it cannot be liquefied, however high pressure may be applied on the gas. Hence, CO_2 cannot be liquefied above its critical temperature.

According to Boyle's Law $P \propto \frac{1}{V}$

or $V \propto \frac{1}{P}$ (At constant Temp)

(37.) (b) $Z = \frac{PV}{RT}$

$$0.5 = \frac{100 \times V}{0.0821 \times 273}$$

$V = 0.112$ L

According to Van der Waals' equation

$$\left(P + \frac{o}{V^2}\right)(V - b) = RT \text{ (For 1 moles)}$$

$$\left[100 + \frac{a}{(0.112)^2}\right](0.112 - 0) = 0.0821 \times 273$$

on solving $a = 1.256 L^2 mol^{-2} atm$

(38.) (c) According to Avogadro's law, equal volumes of all gases under the same conditions of temperature and pressure contain equal number of molecules.

(39.) (b) The two very important conditions for liquefying a gas are

(a) Temperature should be lower than the critical temperature $(T < T_c)$

(b) Pressure should be greater than the critical pressure $(P > P_c)$

(40.) (c)

(41.) (c) $z = 1 + \frac{bp}{RT}$

(42.) (a) Average $K.E. \propto T_{abs}$

(43.) (a) HCl is polar $(H \neq 0)$ and He is non-polar

Therefore, HCl and He atoms will $(H = 0)$ posses dipole-induced dipole interaction

(44.) (d) Greater the value of a easier is the process of liquefaction.

(45.) (c) *Dalton's law of partial pressure*: This law states that the total pressure exerted by a mixture of non-reacting gases is equal to the sum of partial pressure exerted by the individual gases.

$P = P_1 + P_2 + P_3$

Dalton's law of partial pressure follows by the mixture of non-reacting gas but NH_3 reacts with HCl gives NH_4Cl.

$NH_3 + HCl \rightarrow NH_4Cl$.

Hence, Dalton's law of partial pressure is not applicable to $NH_3 + HCl$.

(46.) (b) A polar molecule may polarise the non-polar molecule present in its close vicinity, thereby making it an induced dipole.

The strength of these interactions depends upon the polarising power of molecule and the ease of polarisability of non-polar-molecule.

(47.) (c)

(48.) (c)

(49.) (d) At high temperature and low pressure, behaviour of real *g*as approaches ideal behaviour.

(50.) (a)

	N_2	CO_2	CH_4
	56 g	44 g	16 g
No. of moles	56 / 28	44 / 44	16 / 16
	= 2 mol	= 1 mol	= 1 mol

No. of moles $56/28\ \ 44/44\ \ 16/16 = 2\ \text{mol} = 1\ \text{mol} = 1\ \text{mol}$

Total moles $= 2 + 1 + 1 = 4$ mol.

Partial pressure of CH_4 = mole fraction of CH_4 x total pressure

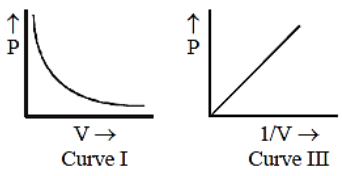
$= 1/4 \times 720 = 180\ \text{mmHg}$

TOPIC WISE PRACTICE QUESTIONS-SOLUTIONS

1. (3) Attractive forces between an ion and a dipole are known as ion - dipole forces and these are not van der Waals forces.
2. (3) PV = nRT is for an ideal gas which follows both isothermal and adiabatic processes.
3. 1) $d \propto P$, Boyle's law, $\left(d = \frac{MP}{RT}\right)$ At sea level pressure
4. 2)When P, V and T are same number of particles will also be same (Avogadro's law)
5. 1) $PV = nRT; n_1T_1 = n_2T_2$; $n_2 = \frac{T_1}{T_2} = \frac{3}{4}$
6. 4) $P = \frac{nRT}{V} = \frac{6}{16.02} \frac{\times 8.314 \times 402}{0.03} \square\ 41648\text{Pa}$
7. (2) Since, P, V and T are same, here flasks will contain the same number of molecules.
8. (2) Because H_2 and Cl_2 gases may react with each other to produce HCl gas hence Dalton's law is not applicable.
9. (2) This type of attractive force operates between the polar molecules having permanent dipole and the molecules lacking permanent dipole. HCl is polar (m ¹ 0) and He is non polar (m = 0), thus gives dipole-induced dipole interaction.
10. 2) $PV = nRT$; $n = \frac{1 \times 10}{76 \times 0.0821 \times 1273} = 1.26 \times 10^{-3}$

    No. of Na atoms $= 1.26 \times 10^{-3} \times 6.02 \times 10^{23} = 7.6 \times 10^{19}$
11. 2) P in mm of Hg = $\frac{0.61 \times 10^3}{1.013 \times 10^5} \times 760 = 4.6\text{mm of Hg}$
12. 1) mole of $N_2 = \frac{56}{28} = 2$, mole of $O_2 = \frac{96}{32} = 3$

    $P_{O_2} = \frac{2}{5} \times 10 = 4\text{atm}$; $P_{N_2} = \frac{3}{5} \times 10 = 6\text{atm}$
13. 1) $\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$ at constant P and T
14. 3)



    Both these graphs represents Boyle's law.
15. 1)

16. 2) Use Grahams' law of diffusion

$$\frac{r_{He}}{r_{CH_4}}=\sqrt{\frac{M_{CH_4}}{M_{He}}}=\sqrt{\frac{16}{4}}=2$$

17. 1) $r_g=\frac{1}{5}r_{H_2}\frac{M_g}{M_{H_2}}=\left[\frac{r_{H2}}{r_g}\right]^2=(5)^2=25;M_g=2\times25=50$

18. 3) Gaseous state of substance has the maximum thermal energy.

19. 3) $V_2=\frac{P_1V_1}{T_1}\frac{T_1}{P_2}=\frac{760}{600}\times\frac{546}{273}\times273=691.6ml$

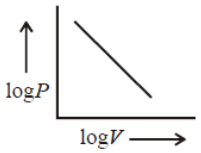
20. 1)

21. 2) According to Boyle's law, *PV* = constant

$\therefore$ log*P* + log*V* = constant

log*P* = – log*V* + constant

Hence, the plot of log*P* vs log*V* is straight line with negative slope.



22. 3) At any given pressure, graph of volume vs temperature (in °C) is a straight line and on extending to zero volume each line intercepts the temperature axis at – 273.15° C.

23. (4) 44 g at STP occupies volume 22.4 litre which is molecular mass of CO2. Molecular mass occupies 22.4 litre at STP.

24. 2) $r\propto\sqrt{\frac{1}{M}};\frac{r_1}{r_2}=\sqrt{\frac{M_2}{M_1}};\frac{3r_1}{r_1}=\sqrt{\frac{M_2}{4}};9=\frac{M_2}{4}$; M_2 = 36 g/mole

25. 2) R = 0.082 litre atm $K^{-1}mol^{-1}$

26. 2) $P_1V_1=P_2V_2$; $760\times500=P_2\times200$; $P_2=\frac{760\times500}{200}=1900MM\ Hg$

27. 4) Volume of gas at STP = $nV_m=n\times22.4L$

$a)n=\frac{14}{28}+\frac{16}{32}=1,\text{volume}=1\times22.4L=22.4L$

$b)n=\frac{4}{4}+\frac{44}{44}=2,\text{volume}=2\times22.4L=44.8L$

c) $n=\frac{7}{28}+\frac{36}{48}=1,\ \text{volume}=1\times22.4L=22.4L$

d) $NH_3(g)+HCl(g)\rightarrow NH_4Cl(s),\text{volume}<<44.8L$

28. 3) Total pressure; P = $\frac{nRT}{V}=\frac{4\times0.0821\times300}{100}=0.985atm$

$p_A=\frac{n_A}{n_A+n_B}.P=\frac{1}{4}\times0.985=0.246atm$

$p_B=\frac{n_B}{n_A+n_B}.P=\frac{3}{4}\times0.985=0.739atm$

Total partial pressure $(P_A+P_B)=0.985atm$

29. 3) $\frac{V_1}{T_1}=\frac{V_2}{T_2}$ at const. pressure $\Rightarrow\frac{22.4}{273}=\frac{V_2}{373},V_2=30.6\ \text{litre}$

30. 2) $CH_4(g)+2O_2(g)\rightarrow CO_2(g)+2H_2O(1)$

$CH_4\left(\frac{16}{16}=1\text{mole}\right)$ and $O_2\left(\frac{64}{32}=2\,\text{mole}\right)$

react completely to produce 1 mole of CO_2 gas and 2 moles of liquid water at 27 °C. Hence,

$$P=\frac{nRT}{V}=\frac{1\times0.082\times300}{3}=8.2\text{atm}$$

31. 1)

$$\text{Most probable velocity}=\sqrt{\frac{2RT}{M}}$$

$$\text{Average velocity}=\sqrt{\frac{8RT}{\pi M}}$$

$$\text{Root mean square velocity}=\sqrt{\frac{3RT}{M}}$$

$$\therefore \underset{\text{velocity}}{\text{Most probable}} : \underset{\text{velocity}}{\text{Average}} : \underset{\text{velocity}}{\text{Root mean square}}$$

$$=\sqrt{\frac{2RT}{M}}:\sqrt{\frac{8RT}{\pi M}}:\sqrt{\frac{3RT}{M}}=\sqrt{2}:\sqrt{\frac{8}{\pi}}:\sqrt{3}$$

32. 1) $\frac{\text{K.E of neon at } 40^0\text{C}}{\text{K.E of neon at } 20^0\text{C}}=\frac{\frac{3}{2}\text{K}\times313}{\frac{3}{2}\text{K}\times293}=\frac{313}{293}$

33. 4) $\left(\frac{\partial P}{\partial T}\right)$ The product PV will have constant value at constant temperature. This is Boyle's law

34. 1) $\frac{u_{CO_2}}{u_{N_2O}}=\sqrt{\frac{T_{CO_2}\times M_{N_2O}}{M_{CO_2}\times T_{N_2O}}}\Rightarrow\frac{x}{4x}=\sqrt{\frac{T_{CO_2}}{44}\times\frac{44}{T_{N_2O}}}\Rightarrow T_{N_2O}=16T_{CO_2}$

35. 4) $u_1\propto\sqrt{\frac{1}{m_1}}$ and $u_2\propto\sqrt{\frac{1}{m_2}}$; $\therefore\frac{u_1^2}{u_2^2}=\frac{m_2}{m_1}\therefore m_1u_1^2=m_2u_2^2$

36. 4) Kinetic theory of gases proves all the given gas laws.

37. 4)

38. 4) Molecules move very fast in all directions in a straight line by colliding with each other but with different velocity.

39. 2) $K.E_{avg}=\frac{3}{2}k_BT$

40. 4) Due to phase transfer distance between particle changes, because temperature remains constant, so KE remains constant.

41. 4) $U_{rms}=\sqrt{\frac{3RT}{M_w}}$

42. 2) If attraction are disappear then pressure of real gas ↑

43. 4) $P_{ideal}=P_{real}+\frac{n^2a}{V^2}$

44. 2) Apply $\frac{U_1}{U_2}=\sqrt{\frac{T_1M_2}{T_2M_1}}$; $\frac{U_{SO_2}}{U_{O2}}=\sqrt{\frac{T_{SO_2}\times32}{64\times303}}=\sqrt{\frac{T_{SO_2}}{606}}$

45. 2) Velocity and hence average K.E is maximum in the gaseous state.

46. 1) Sine for H_2 and He, PV> nRT and $Z=\frac{PV}{nRT}$ Hence Z is more than 1

47. 4) van der Waals constant *b* = 4 times the actual volume of 1 mole molecules $= 4VN_0$

48. 1) $P = \frac{n^2a}{V^2}; a = \frac{PV^2}{n^2} = atm\ \ dm^6mol^{-2}$

49. 3) Higher the critical temperature more easily will be the gas liquify. Now since most easily liquifiable gas shows larger deviation, NH3 will show maximum deviation from ideal behaviour.

50. (2) At low pressure and high temperature real gas nearly behave like ideal gas. Hence deviation is minimum from ideal behaviour.

51. 3) $\left(P + \frac{a}{V^2}\right)(V - b) = RT; Here\left(P + \frac{a}{V^2}\right)$ represents the intermolecular forces.

52. (1) In van der waal's equation 'b' is for volume correction

53. (3)

54. (2) Boyle's temperature, $T_b = \frac{a}{Rb}$ and critical temperature $T_c = \frac{8a}{27Rb} \therefore \frac{T_b}{T_c} = \frac{27}{8}$

55. 2) van der Waals equation for one mole of a real gas is

$$\left(P + \frac{a}{V^2}\right)(V - b) = RT \text{ or } PV = RT + Pb + \frac{ab}{V^2} - \frac{a}{V}$$

At high pressure, then van der Waals gas equation

reduces to PV = RT + Pb; or $\frac{PV}{RT} = 1 + \frac{Pb}{RT}$; $\therefore$ Compressibility factor Z = $\frac{PV}{RT} = 1 + \frac{Pb}{RT}$

56. 3) Easily liquefiable gases have greater intermolecular forces which is represented by high value of 'a'. The greater the value of 'a' more will be liquefiability. So, the order is Q < S < P < R.

57. (3) The correct order of viscosity of the given liquids is dimethyl ether < methyl alcohol < water < glycerol.

58. (1) Since surface tension depends on the attractive forces between the molecules, and hydrogen bonding a special type of dipole-dipole interactions in (b), (c) and (d) which is stronger than London forces of attraction in hexane.

59. (1) As intermolecular forces are least in case of petrol. Thus, it has highest rate of evaporation.

60. (b)

NEET PREVIOUS YEARS QUESTIONS-EXPLANATIONS

1. (3) In real gas equation,

van der waal constant $(\alpha) \propto$ forces of attraction.

2. (1) van der waal constant 'α', signifies intermolecular forces of attraction. Higher is the value of 'α', easier will be the liquefaction of gas.

3. (1) Given, $n_{H_2} = n_{O_2}$ and $t_{H_2} = t_{O_2}$

According to Graham's law of diffusion for two different gases.

$$\frac{r_{H_2}}{r_{O_2}} = \frac{v_1/t_1}{v_2/t_2} \Rightarrow \sqrt{\frac{M_{O_2}}{M_{H_2}}} = \sqrt{\frac{32}{2}}\ ;\ \frac{1/2}{1/x} = \sqrt{16} = 4\ ;\ \frac{x}{2} = 4\ ;\ \therefore x = 8$$

$\therefore$ Fraction of $O_2 = 1/8$

4. 1) Ratio of weight of gases = $w_{H_2} : w_{O_2} = 1:4$

Ratio of moles of gases = $n_{H_2} : n_{O_2} = \frac{1}{2} : \frac{4}{32}$; $\therefore$ Molar Ratio = $\frac{1}{2} \times \frac{32}{4} = 4:1$

5. 3) $(V_m)_{real} < (V_m)_{ideal}$; $Z = \frac{(V_m)_{real}}{(V_m)_{ideal}}$

Z < 1 and attractive forces are dominant.

6. 4)

PV = nRT

n = 1.8/18 = 0.1 mole

P = 1 bar

T = 374 + 273

= 647 K

$V = \frac{nRT}{P} = \frac{0.1 \times 0.083 \times 647}{1} = \mathbf{5.37\ L}$

7. 1): By Boyle's law ; $P_1V_1 = P_2V_2$

1 bar × 600dm^3 = P_2 × 150 dm^3 ; P_2 = 4 bar

8. 4) Number of moles of $N_2 = \frac{7}{28}, 0.25$; Number of moles of $Ar = \frac{8}{40}, 0.2$

Partial pressure of $N_2 = \frac{n_{N_2}}{n_{N_2} 4n_{Ar}}.P_{Total} = \frac{0.25}{0.45} \times 27 = 15\ bar$

9. 3) Option (3) correct

10. 2) $n_1(O_2) = \frac{4}{32} = 0.125$; $n_2(H_2) = \frac{2}{2} = 1$; n = 0.125 + 1 = 1.125 ; $PV = nRJ$

(V = 1L, R = 0.082L, T = 273 K)

$P = \frac{nRJ}{V} = \frac{1.125 \times 0.082 \times 273}{1} = 25.18l$

11. $p_i = x_i\ p_i$ is Raoults Law