Gaseous State

Different states of matter

Chemistry is defined as - the scientific study of MATTER, especially its composition, properties and transformation.

Matter - anything that occupies space, possesses mass and can be felt by one of the five senses.

On the basis of physical state, matter can be generally classified into solids, liquids and gases.

Solid	Liquid	Gas
fixed **shape and size**,	not fixed shape but fixed size,	nor fixed shape or fixed size,
could not be **compressed**	could be compressed to a minimal extent	could be compressed to a large extent
fixed **position of the constituent** particles	moving constituent particles but movement relatively slow & within the body of liquid	very fast-moving constituent particles in random motion
strong **force of attraction** between constituent particles	moderate force of attraction between constituent particles	force of attraction between constituent particles negligible

1. There are three different compounds A, B and C kept in three different cylinders. All of them exist in the three different states of matter. The intermolecular force in compound B is the highest while compound A has the lowest intermolecular force between the molecules. Which of the following statements is correct?
    a. A: gas; B: liquid; C: solid
    b. A: gas; B: solid; C: liquid
    c. A: solid; B: liquid; C: gas
    d. A: solid; B: liquid; C: gas

e. Sodium chloride, water and air represent three states of matter – solid, liquid and gas.

Which row is correct?

	sodium chloride	water	air
A	particles held in rigid structure	can easily be compressed	can easily be compressed
B	particles stationary	particles move	cannot easily be compressed
C	particles stationary	particles stationary	particles move
D	resistant to change of shape	cannot easily be compressed	can easily be compressed

Kinetic Theory of Gas and its Postulates

1. Every gas is composed of **tiny particles called molecules**. Molecules of one kind of gas are **identical** in all respects.
2. The gas molecules are **incompressible, rigid spheres**.
3. The **volume occupied by the individual particles of a gas is negligible** compared to the volume of the gas itself.
4. The particles of an ideal gas exert **no attractive or repulsive forces on each other or on their surroundings**. It is due to the high kinetic energy of the molecules that overcomes weak forces between them.
5. **Gravitational force** or acceleration due to gravity is also **negligible** for the gas molecules.
6. Gas particles are in a **constant state of random motion** and move in straight lines until they collide with another body.
7. The collisions exhibited by gas particles are completely **elastic**; when two molecules collide, total **kinetic energy is conserved**.
8. **Pressure** is exerted by the gases due to the **continuous bombardment of the gas molecules** with the wall of the container.
9. The **average kinetic energy** of gas molecules is directly proportional to **absolute temperature** only; this implies that all molecular motion ceases if the temperature is reduced to absolute zero.

1) *Give reason: Gases do not settle at the bottom of the vessel.* 1

2) *What are basic postulates of kinetic theory of gas?* 4/5

2. What are the assumptions made in the kinetic theory about an ideal gas?
   I. There are no forces of attraction between the molecules.
   II. The molecules are in a state of continual random motion.
   III. The size of the molecules is negligible.
   a. All three statements are true.
   b. Only I and III are true.
   c. Only III is wrong.
   d. Only II and III are three.

3. Pressure exerted by a gas in a container is due to
   a. Collisions of gas molecules with the wall.
   b. Collision of the gas molecules with each other.
   c. Collisions of the gas molecules with the walls and with each other.
   d. All of the above.

Gas laws

Boyle's Law

At constant temperature, the **volume** of a given mass of a gas is inversely proportional to its **pressure**.

Let P and V be the pressure and volume of a given mass of gas at a constant temperature, then

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

Or, $V = \frac{K}{P}$ (where K is proportionality constant)

Or, $VP = K$

Let us consider a certain mass of gas has pressure P_1 and volume V_1 and when the pressure changes to P_2 the volume changes into V_2. Then according to Boyle's law,

$V_1P_1 = K$.............. (1)

$P_2 V_2 = K$………….. (2)

From equation 1 and 2,

$\boxed{P_1V_1 = P_1V_2}$ at constant temperature for a given mass of a gas.

3) *At what condition the value of P x V is always constant?* 2
4) *State Boyle's law.* 1
5) *State and explain Boyle's law.* 3
6) *State Boyle's law and derive $P_1V_1=P_2V_2$.* 1+1

Significance of Boyle's law

At high altitudes atmospheric pressure is low; therefore, same mass of gas (oxygen) occupies more volume. Therefore, while inhaling (breathing in) a person doesn't get a sufficient amount of oxygen. Due to this reason, mountaineers carry oxygen cylinder.

7) *What is the significance of Boyle's law?* 1
8) *Mention an important application of Boyle's law.* 1
9) *On the basis of Boyle's law, explain why mountaineers carry oxygen cylinders with them.* 2

Graphical representation of Boyle's law

A plot of volume versus 1/pressure of constant mass of a gas at constant temperature gives slanted line.

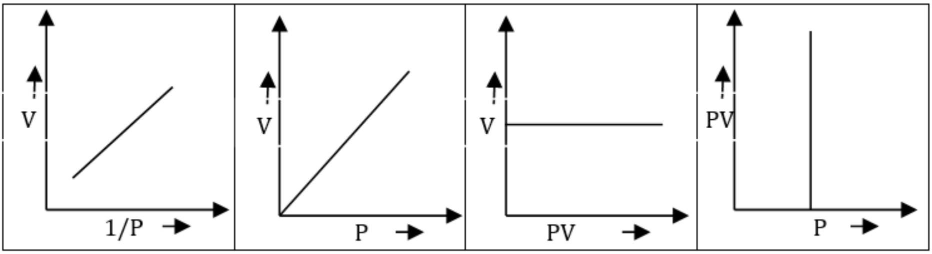
A plot of volume versus pressure of constant mass of a gas at constant pressure gives a parabolic curve.

A plot of PV versus V and PV versus P gives a straight horizontal line.

(Refer to textbooks or classwork copies for the graphs)

10) *State Boyle's law and plot a graph pressure (P) versus volume (V) in isothermal condition.* 2
11) *How would you justify Boyle's law by graphical explanations?* 4
12) *State and explain Boyle's law with graph?*
13) *State Boyle's law and draw (i) P vs V (ii) V vs 1/P (iii) PV vs P (iv) PV vs V graphs to support Boyle's law.* 2+3
14) *Plot pressure volume relationship to explain Boyle's law.*

1. *Which of the following graph proves Boyle's law?*



Charles's Law

<u>Statement</u>

The **volume** of given mass of gas is **directly proportional** to the **temperature** in absolute scale at a constant pressure.

Let, a given mass of a gas occupies volume V at absolute temperature T, then according to Charles's law,

$$V \propto T$$

<u>Explanation</u>

If V_1 and T_1 be the volume and temperature of fixed mass of gas and if temperature is changed to T_2 so that the volume becomes V_2. Then

$V_1 \propto T_1$ or, $V_1 = kT_1$ or $V_1/T_1 = k$........ (1)

And $V_2 \propto T_2$ or, $V_2 = kT_2$ or, $V_2/T_2 = k$......... (2)

Then, from equation (1) and (2),

$$\boxed{\frac{V1}{T1} = \frac{V2}{T2}}$$

15) State Charles's law. 1

16) State and explain Charles law.

17) *How is the Charles's law explained quantitatively in the light of kinetic theory of gases?* 2

Graphical representation and concept of absolute zero

(Refer to textbooks or classwork copies for the graphs and explanation)

18) *Draw a volume (V) vs temperature (t^0C) graph and find out the temperature correspondingly to zero volume. Name that temperature.*
19) *Sketch the diagram for the variation of volume of a given mass of ideal gas with temperatures at constant pressure. Indicate the absolute zero in the diagram.* 2
20) *Plot the temperature-volume relationship indicating absolute zero. How did Charles's law lead to the development of the absolute temperature scale?* 2
21) *How did Charles's law give the concept of the absolute scale of temperature?* 2

Numericals

22) *One liter of a gas at 0^0C is heated to 100^0C keeping the pressure constant. What will be the new volume at 100^0C? (ans=1.366 liter)* 2
23) *During the day at 27 °C a cylinder with a sliding top contains 20.0 liters of air. At night it only holds 19 liters. What is the temperature at night?*

    a. 20 °C b. 285 K c. 25 K d. 285 °C
24) *How much increase in temperature is necessary to increase the volume of half liter of a gas by 40% at 25^0C, keeping the pressure constant? (ans=119.2^0C or 119.2 K)* 4

Combined gas equation

(Refer to textbooks or classwork copies)

25) *Derive combined gas equation?*

Numericals

26) *At what temperature would the volume of a gas be doubled, if the pressure at the same time increases from 700 to 800 mm, the gas being at 0^0C initially?* *(ans = 624K or 351^0C)* 2

27) *Calculate the pressure required to compress 2000ml of a gas at 700mm pressure and 20^0C into a container of 100ml capacity at temperature of -150^oC.* *(ans = 5877.13 mm or 24.63 atm)* 2

Solution: Given, V_1= 2000ml

P_1=700mmHg

$T_1=20^0C=20+273K=293K$

V_2= 100 ml

P_2=?

$T_2=-150^0C=-150+273K=123K$

We know,

$P_1V_1/T_1= P_2V_2/T_2$

28) *A gas cylinder cooking gas can withstand up to pressure 14.9 atm. The pressure gauge of cylinder indicates 12 atm at 27^0C. Due to sudden fire in the building its temperature starts rising. At what temperature will the cylinder explode?* *(ans = above 99.5^0C)* 3

29) *A balloon can hold 1000cc of air before bursting. The balloon can hold 975cc of air at 5^0C. Will it burst when it is taken into a home at 25^0C? Assume pressure remains constant.* *(ans = yes)* 2

30) *Spherical balloon of 21 cm diameter is to be filled with hydrogen gas at NTP from a cylinder containing gas at 20 atm and 27^0C. If the cylinder can hold 2.66 liters of water vapour at NTP, calculate the number of balloons that can be filled up.*

Solution: Given,

For cylinder, at NTP V_1= ? P_1= 1 atm T_1= 273 K

P_x = 20 atm $T_x = 27^0C$= 300 K V_x= 2.66 l

We know that, $P_1V_1/ T_1= P_xV_x/T_x$

V_1= 48.43l liters

Out of total gas 48.431 liters of the gas 2.66 will be left in the cylinder, So, remaining gas available to fill balloons = 48.431-2.66 = 45.771 liters

= 45771 cc

Volume of balloon in NTP,

$V_2 = 4/3\ \pi r^3 = 4/3\ \pi\ 10.5^3 = 4849\ cm^3$

$P_2 = 1$ atm $\quad\quad T_2 = 273$ K

No of balloons that can be filled $= \dfrac{\text{total volume of gas in the cylinder}}{\text{volume of one balloon}}$

= 45771/4849= 9.44

31) *A toy balloon blown up at 100 °C, has a volume 960cc. At this stage the balloon is distended to 7/8 of its maximum stretching capacity. Will the balloon burst, if it is brought to a room having temperature 250 °C? If not, calculate the temperature at which the balloon bursts.* 4

Ideal gas and ideal gas equation

<u>Derivation of ideal gas equation</u>

(Refer to textbooks or classwork copies)

32) *Derive the relation PV = nRT.* 2/3/4

33) *State Boyle's law and Charle's law. Derive PV = nRT.* 2+4,5

Universal gas constant and its significance

34) *How would you define universal gas constant, R?* 1

35) *What is universal gas constant?* 2

<u>Concept of ideal gases</u>

(Refer to textbooks or classwork copies)

36) *Under what condition a gas does follows the relation, PV = nRT?*

37) *What is an ideal gas?* 1

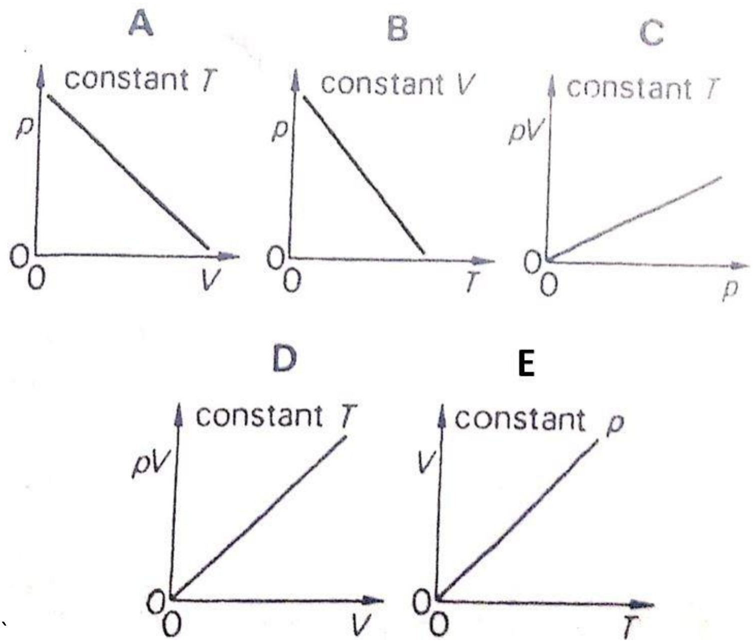
38) *Under what condition will a gas behave nearly like an ideal gas?* 1

39) *What do you mean by ideal gas and real gas?*

40) *Why do gases not show ideal behavior at low temperature and high pressure?* 2

41) *Differentiate between real gas and ideal gas?* 2

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



2. At constant temperature, for a given mass of an ideal gas
   a. The ratio of pressure to volume always remains constant.
   b. Volume always remains constant.
   c. Pressure always remains constant.
   d. The product of pressure and volume always remains constant.
3. When an ideal gas at NTP is heated to 273^0C at constant pressure, the density of the gas would be
   a. Constant b. Halved c. Doubled d. trebled
4. When 10 ml of a gas is heated from 100^0C to 200^0C, what will be its final volume?
   a. 100 ml b. 120 ml c. 12.68 ml d. 200 ml
5. In the ideal gas equation PV = nRT the value of R depends on

a. Nature of a gas
b. Temperature of the gas
c. Heat capacity of gas
d. Units of measurement

6. When the temperature is doubled and pressure is halved, the volume of gas is
   a. Constant b. Half c. Double d. quadruple
7. Which of the following exerts the highest pressure?
   a. 1 mol of N_2 at 0^0C in 11.2 liter vessel
   b. 1 mol of N_2 at 27^0C in 22.4 liter vessel
   c. 1 mol of H_2O at 27^0C in 1 liter vessel
   d. 1 mol of C_4H_{10} at 27^0C at its normal boiling point
8. Real gases approach behavior of ideal gases at
   a. High temperature and low pressure
   b. High pressure and low temperature
   c. Low temperature and high pressure
   d. Low temperature and low pressure
9. Under what conditions of temperature and pressure will a real gas behave most like an ideal gas?

	Temperature	Pressure
a.	Low	low
b.	Low	high
c.	Standard	standard
d.	High	low
e.	High	high

10. For a real gas, deviations from ideal behavior are maximum at:
    a. -10^0C and 5.0 atm
    b. -10^0C and 2.0 atm
    c. O^0 C and 1.0 atm
    d. 100^0C and 2.0 atm

4. Which statement about ideal gases is correct?
   A Ideal gases have finite particle volume and no intermolecular forces of attraction.
   B Ideal gases have finite particle volume and weak intermolecular forces of attraction.

C Ideal gases have zero particle volume and no intermolecular forces of attraction.

D Ideal gases have zero particle volume and weak intermolecular forces of attraction.

Deviation of real gas from ideality

(Refer to textbooks or classwork copies)

42) *Why do gases show deviation from ideal behavior at low temperature and high pressure?* 2
43) *State the proper condition for the deviation of gases from ideal behavior.* 1/2

Numericals

44) *Two moles of ammonia are enclosed in a five liters flask at 27^0C. Calculate the pressure exerted by the gas? (ans = 9.852 atm)* 2
45) *One mole of a gas occupies a volume of 1 liter at 27^0C. What will be the pressure of the gas? (ans = 24.63 atm)* 2
46) Find the number of moles of molecules present in 50 mL of an ideal gas exerting a pressure of 770 mm at 250^0C (R= 0.0821 L atm $mole^{-1}$ K^{-1}) [ans = 1.18×10^{-3} mol] 2
47) *Calculate the mass of oxygen gas whose volume is 320 mL at 17^0C and 2 atmospheres pressure. (ans = 0.86 g)* 2
48) *A fire extinguisher with a capacity 5 liters contains 2 kg of CO_2 gas. What volume of the gas will be delivered to extinguish a fire at STP? (ans = 1013.68 litres)* 4
49) *A carbon dioxide fire extinguisher of 3 litres capacity contains 4.4 kg of carbon dioxide. What volume of gas could this extinguisher deliver at NTP?(ans = 2238.33 l)*
50) *0.23 g of a volatile liquid occupies 126.4 cc at 27^0C and 760 mm Hg pressure. Calculate the molecular weight of the liquid. How many molecules of the liquid are present in 0.23 g? (ans 44.83, 3.09×10^{21})* 4

51) *525 cc of a gaseous compound at 28^0C and 730 mm Hg pressure was found to be 0.9 g. What will be the volume of 2g of the gas at 30^0C and 760 mm Hg pressure? [Given R= 0.0821 liter atm $K^{-1}mol^{-1}$]* 4

Solution:

Given, V_1= 525 cc = 0525/1000 l =0.525 l

T_1= 28+273 K= 301K

P_1= 730 mm Hg =730/760 atm

m_1 = 0.9 g

From ideal gas equation,

$P_1V_1 = m_1/M\ RT_1$

m_2 = 2 g

T= 30^0C = 30+273 K = 303 K

P= 760 mmHg = 1 atm

V = ?

Again, from ideal gas equation,

PV = m/MRT

Ans: V = 1.13 ltr

52) *An evacuated glass vessel weighs 50 gm when empty, 148 gm when filled with a liquid of density 0.98 gm/cc and 50.5gm when filled with an ideal gas at 760 mm of Hg at 300K. Determine the molecular mass of the gas.(123.15 amu)*

53) *A hydrocarbon C_xH_y has mass ratio between hydrogen and carbon 1:10.5. One liter of the hydrocarbon at 127^0C and 1 atm pressure weighs 2.8 g find the molecular formula of the hydrocarbon.* 4

54) *A vessel contains 12 g of an ideal gas at t^0C temperature 1 atm pressure. When temperature increased to by 10^0C at the same volume, the pressure increases by 10%? Calculate the volume and initial temperature. (Molecular mass= 120)* *(ans: 0.821 l, 100K)* 4

55) *An evacuated glass vessel weighs 50gm when empty, 148 gm when filled with a liquid of density 0.98 g/cc and 50.5 gm when filled with an ideal gas at 760 mm Hg at 27^0C. Calculate the volume of the ideal gas at STP.* *(ans:91 cc)* 4

56) *The volume of a gas weighing 8 grams was expanded at a constant temperature until the pressure of the gas reduced into half of its initial value. It was found 500 ml of the gas weighed 1.25 g. What was the original volume of the gas?*

57) *A flask of 0.3 liter capacity was weighed after it had been evacuated. It was then filled with a gas of unknown molecular mass at 1.0 atm pressure and temperature of 300K. The increase in mass of the flask was 0.997 g. Calculate the molecular mass of the gas.* 4

58) *A) Write a balanced chemical reaction when sodium carbonate is reacted with dilute sulfuric acid.*

If the reaction is carried out by mixing 21.2 g of pure sodium carbonate and an excess of dilute sulphuric acid.

   a. *Which is the limiting reactant?* 1
   b. *How many grams of sodium sulphate are formed?* 1
   c. *What volume of CO_2 gas is produced at 20^0C and 655 mmHg pressure?* 2
   d. *Calculate the number of moles of H_2O produced.* 1

Dalton's law of partial pressure

It states "The **total pressure** of a mixture of non-reacting gases is the sum of **partial pressure** of the constituent gases." The partial pressure of a component gas is defined as the pressure of the gas, if it was occupying the whole as the mixture volume alone.

Let us consider three gases A, B and C are non-reacting gases and are mixed together in a vessel. The mixture exerts a total pressure of P_T. Further suppose the partial pressures of the three gases are P_1, P_2 and P_2 respectively. Then according to Dalton's law of partial pressure,

$$\boxed{P_T = P_1 + P_2 + P_3}$$

59) State Dalton's law of partial pressure. 2

60) Derive Dalton's law of partial pressure? 2

Application of Dalton's law of partial pressure

61) State and explain the Dalton's law of partial pressure. What is its application? 5+1

5. Zinc metal is allowed to react with excess hydrochloric acid (an aqueous solution of HCl gas) according to the equation;

$$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$$

The resulting hydrogen gas is collected over water at 25°C, while the barometric pressure is 745.4 mm Hg. What will be the pressure exerted by H_2 gas? (Aqueous tension of water vapour at 25 °C is 23.8 mm Hg).

a. 745.4 mm Hg b. 769.2 mm Hg c. 23.8 mm Hg d. 721.6 mm Hg

6. In a vessel of 8.4 gm of ethane and 5.6 gm of But-2-ene are kept. The total pressure of the system is 100kpa. The partial pressure of the ethane is:

a. 25 kpa b. 50 kpa c. 75 kpa d. 100 kpa

Numericals

2. *A 1.00 L sample of dry gas at 25^0C has the following compositions: 0.8904 g of N_2, 0.2741 g of O_2, 0.0152 g of Ar, 0.00107 g of CO_2 Given $R = 0.0821\ L\ atm\ K^{-1}\ mol^{-1}$*

What are the partial pressures for each component's gas in the mixture? What is the total pressure? *(ans $p(N_2)$= 0.778; $p(O_2)$ = 0.209; $p(Ar)$ = 9.29 x 10^{-3} ; $p(CO_2)$ = 5.94 x 10^{-4} ; P_T= 0.9979 or 0.998 atm)* 5

3. *When 2 g of a gas (A) is introduced into an evacuated flask kept at 25⁰C, the pressure is found to be one atmosphere. If 3 g of another gas (B) is added to the same flask, the total pressure becomes 1.5 atmospheres at the same temperature. Assuming the ideal behavior of gases, calculate the ratio of molecular masses.* *(ans=1:3)* 5
4. *Two vessels of capacity 1.5 liters and 2 liters contain hydrogen gas and oxygen gas respectively under a pressure of 750 mm and 100 mm. The gases are mixed together in a 5-litre vessel. What will be the final pressure of the mixture?*

Solution:

For Oxygen: before mixing V_O= 2 ltr P_O = 100 mm

After mixing, V_1 = 5 liter partial pressure of O_2, p_1 = ?

At constant temperature applying Boyle's law, $V_O P_O = V_1 p_1$

For hydrogen: before mixing V_h = 1.5 ltr P_h = 750 mm

After mixing, V_3= 5 litre partial pressure of H_2, p_2 = ?

At constant temperature applying Boyle's law, $V_H P_H = V_1 p_2$

From Dalton' law of partial pressure,

Total pressure P= p_2+p_1

5. *The value (volume) of carbon monoxide gas collected over water at 25^0C is 680 cc with a total pressure of 752 mm Hg. The vapour pressure of water at 25^0C is 23.8 mm Hg. Determine the partial pressure of CO in the container.* *(ans: 728.2 mm Hg)* 1.5

Graham's law of diffusion

Statement

Under similar conditions of temperature and pressure, the **rate of diffusion** of gases is inversely proportional to the **square root of their densities**.

Mathematical expression and explanation

Considering r, d, the rate of diffusion and density of a gas,

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

Similary if r_1 and r_2 are the rate of diffusion and d_1 and d_2 are the densities of two gases,

$r_1 \propto \frac{1}{\sqrt{d1}}$ or, $r_1 = \frac{k}{\sqrt{d1}}$ ....(1)

$r_2 \propto \frac{1}{\sqrt{d2}}$ or $r_2 = \frac{k}{\sqrt{d2}}$ ....(2)

From equation (1) and (2),

$$\boxed{\mathbf{\frac{r1}{r2} = \sqrt{\frac{d2}{d1}}}} \text{......................... (3)}$$

From Avogadro's hypothesis, we know that, molecular mass of a gas = 2 x its vapour density,

Or, d = M/2 So correspondingly, $d_1 = M_1/2$ and $d_2 = M_2/2$

Where M_1 and M_2 are the molecular of the two gases.

Putting these values in equation (3), we get

$$\boxed{\mathbf{\frac{r1}{r2} = \sqrt{\frac{M2}{M1}}}} \text{..........................(4)}$$

This is another expression of Graham's law of diffusion.

6. *State Graham's law of diffusion?* 1/2
7. *State and explain Graham's law of diffusion.* 5/3
8. *What are the applications of Graham's law?* 2

Numericals

9. *A gas X diffuses five times as rapidly as another gas Y. Calculate the ratio of molecular mass of X and Y.* *(ans: x:y = 1:25)* 2
10. *The relative densities of carbon dioxide and ozone are 22 and 24 respectively. If 12 ml of Carbon dioxide diffuse in 100 seconds; what volume of ozone will diffuse in the same time under similar conditions? (ans= 11.5 ml)*
11. *How long will it take 500 ml of hydrogen gas to diffuse through a partition if 250 ml of oxygen diffuses in 50 minutes under similar conditions?* *(ans = 25 minutes)* 3

Given, volume of H_2 (V_1) = 500 ml

t_1=?

M_1 = 2 amu

Volume of O_2 (V_2) = 250 ml

t_2 = 50 minutes

M_2= 32

$(M_1/M_2) = (r_2/ r_1)^2$

12. *How long will take 600 mL of H_2 gas to diffuse through a porous partition, if 300 mL of O_2 diffuse through it in 10 minutes under identical conditions?* *(ans: 5 minutes)* 4
13. *Through the two ends of a glass tube of length 2 meters, HCl (hydrogen chloride) and NH_3 (ammonia) gases are allowed to enter. At what distance ammonium chloride will first appear?* *(ans: 1.18m from NH_3 end and 0.82m from HCl end)* 6
14. *What are relative diffusion rates of Methane (CH_4) and Sulphur dioxide (SO_2)? If these two gases are simultaneously introduced into opposite ends of 100cm tube and allowed to diffuse towards each other, at what distance from the SO_2 end will the molecules of the two gases meet?* *(ans =Rate CH_4/ rate SO_2 = 2:1, 33.33 cm)* 5
15. *A saturated hydrocarbon having molecular formula C_nH_{2n+2} diffuses through a porous membrane twice as fast as Sulphur dioxide. Determine the molecular formula of the hydrocarbon. (ans = CH_4)* 4

16. *The rate of diffusion of a saturated hydrocarbon (C_nH_{2n+2}) gas is 1.206 times that of SO_2 gas under identical conditions. Find the molecular mass and the value of 'n' for the gas. (Molecular mass of SO_2 =64) (Ans: molecular mass = 44, n=3)* 2

Suppose, rate of diffusion of SO_2 = x
Rate of diffusion of hydrocarbon = 1.206 x

11. Steam distillation is based on
    a. Boyle's law
    b. Charles's law
    c. Dalton's law of partial pressure
    d. Avogadro's law
12. If the absolute temperature of the gas is doubled and the pressure is reduced to half, the volume of the gas will be:
    a. Unchanged c. Doubled
    b. increase 4 folds d. reduced to 1/4
13. Rate of effusion of a gas depends on
    a. Temperature b. Pressure c. Density d. All of them
14. Rate of diffusion of hydrogen is greater than that of oxygen by
    a. Twice b. 4 times c. 8 times d. 16 times
15. Gas A diffuses five times faster than gas B. The ratio of the densities of gases A and B is:
    a. 1/5 b. 1/10 c. 1/20 d. 1/25
16. Which gas diffuses most rapidly?
    a. NO_2 b. CO_2 c. O_2 d. NH_3
17. Which of the following have highest rate of diffusion?
    a. O_2 b. CO_2 c. NH_3 d. N_2
18. The rate of diffusion of a gas is inversely proportional to the:
    a. Square of its molecular weight
    b. Square root of its molecular weight
    c. Square root of reciprocal of its molecular weight
    d. Reciprocal of its molecular weight

*****This is not a complete note. It is just to guide you. It is recommended to study prescribed textbooks along with this material. *****