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chemistry note(SSLC second chapter)

SSLC CHEMISTRY

CHAPTER WISE NOTES

GAS LAWS AND MOLE CONCEPT

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Unit 2

GAS LAWS AND MOLE CONCEPT

Matter can be classified as solid, liquid, & gas. Compare to solid and liquid, gases have lot of characteristics features. Some of the properties of gases are given below.

- Each gas contains numerous minute molecules
- when compare to the total volume of a gas, the real volume of molecule is very less.
- The molecule of a gas are in a state of rapid random motion in all direction.
- As a result of the random motion of the gas molecules, they colloid with each other and also colloid with the walls of the container, In which it is kept.
- As the collision of the molecules are perfectly elastic in nature, there is no loss of energy.
- There is no attraction between the gas molecules and with the walls of the container.

From above statement we can conclude that.

Energy of gas molecules.	Very high
Distance between gas molecules.	Very high
Freedom of movement of molecules.	Very high
Attractive force between molecules.	Very less

Volume, temperature, pressure of a gas:

A) **Volume of a gas.**

Volume of a gas is the volume of the container with it occupies.

If a gas which is kept in a cylinder having a volume of 1 liter, is completely transferred to another 5 litter cylinder then its new volume become 5 liter.

B) **Pressure of the gas.**

Force exerted per unit Area is called pressure.

Pressure of the gas is the force experienced per unit area on the inner surface of the container. as a result of the collision of the gas molecules on the surface.

Force on unit area= total force exerted on the surface/ surface are.

C) **Temperature of gas.**

When we heated a gas. The kinetic energy of a gas is increases and molecules are move very fastly.

Temperature of gas is defined as the average kinetic energy of molecule in a substance.

Gas laws:

law which describe the properties of gases with respect to temperature, volume, pressure, of gas re known as gas laws. The three important gas laws are,

1) Boyle's law
2) Charle's law
3) Avagdro's law.

A) **Boyle's law: (relation between volume and pressure of gas)**

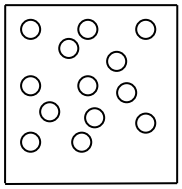
Boyle's law state that, at constant temperature, volume of definite mass of gas is inversely proportional to its pressure.

If P is the pressure and V is the volume of gas then, PxV is constant.

$V \alpha 1/P$ ⟶ mathematical expression.

$P \times V = A$ constant ⟶ mathematical equation.

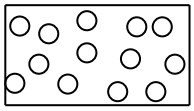
$P_1V_1 = P_2V_2$ ⟶ practical equation



1 atm

1 L

picture A



2 atm 0.5L

picture B

from the above diagram, picture A have 1L volume and 1atm pressure. T constant temperature, when we increase the pressure as 2 atm, the volume of cylinder become 0.5L. ie, (at constant temperature, volume of a gas is inversely proportional to pressure of that gas).

Situation related to Boyle's law:

1) The size of air bubble rising from the bottom in an aquarium increases.
2) The size of climate balloon increases as they move in upward direction to the higher altitude in the atmosphere.
3) When an inflated balloon is immersed in a water, its size increases

B) **Charel's law(relation between volume and temperature of a gas**)

Charel's law is defined as at constant pressure, the volume of a definite ms of a gas is directly proportional to the temperature in Kelvin scale.

Let V is the volume and T is the temperature, then

$V \alpha T$ ⟶ mathematical expression.

$V/T = K$ ⟶ mathematical equation.

$V_1/T_1 = V_2/T_2$ ⟶ practical equation

Situation related to Charles law,

When an inflated balloon is kept in sunlight, it will burst.

Vehicle tyres are not fully inflated during summer season.

When an inflated balloon kept in cold water, its size decreased.

C) **Avagadros law: (Relation between volume and number of moles)**

Avagadros law states that at constant temperature and pressure the volume of a gas is directly proportional to the number of molecules. Let V is the volume and n is the number of moles, then

$V \alpha n$ ⟶ mathematical expression.

$V/n = k$ ⟶ mathematical equation.

$V_1/n_1 = V_2/n_2$ ⟶ practical equation

Relative atomic mass:

The mass of an atom is compared to the mass of another atom and expressed as a number, which shows how many times it is heavier than the other atom. The atomic mass of elements are expressed by considering 1/12 as one unit.

Gram Atomic Mass & Gram Molecular Mass:

A) Gram atomic mass (GAM)

Atomic mass of the element hydrogen($_1H$) is 1. Hence 1g of hydrogen is known as 1GAM.

Similarly, atomic mass of carbon (C) is 12, and atomic mass of Nitrogen(N) is 14, when we take 12g of carbon and 14g of nitrogen both are 1 GAM.

The mass of an element in gram equal to its atomic mass is called 1 gram atomic mass (GAM) of the element. This may also be shorted as 1 gram atom

We know atomic mass of carbon is 12, when we take 12g of carbon which is 1GAM.

One gram atomic mass(1GAM) of any element contain atoms. This number is known as **Avagadro number.** Indicated as **NA**

Any substance contain NA (**Avagadro number)** atoms we called 1 mole of atoms.

Eg: atomic mass of Hydrogen(H) is 1.

1g of H is known as 1GAM. It contain NA(**$6.022x10^{23}$**) atoms and we call it is one mole of hydrogen atoms.

Atom	Atomic mass	Mass taken in g	Number of atoms	GAM
H	1	1	$6.022x10^{23}$	1
He	4	4	$6.022x10^{23}$	1
N	14	28	$2x6.022x10^{23}$	2
C	12	60	$5x6.022x10^{23}$	5
Cl	35.5	355	$10x6.022x10^{23}$	10

B) Molecular mass and gram molecular mass:

Method to find molecular mass of a compound.

Eg: H_2O

We know atomic mass of H=1 and O=16

H_2O contain 2 H and 1 Oxygen atom, so its molecular mass become

2x1 + 1x16 = 2+16 =18 (molecular mass of H_2O=18g)

Similarly: molecular mass of glucose($C_6H_{12}O_6$)

Glucose contain 6 carbon atoms 12 hydrogen atoms and 6 oxygen atoms.

We know the atomic masses of C=12 O=16 H=1

Then the molecular mass of glucose become

6x12 + 12x1 + 6x16 = 72+12+96 =180

Gram Molecular Mass (GMM):

The amount of substance in grams equal to its molecular mass is called gram molecular mass.

One gram of any substance contains Avagadro number of molecules.

Any substance contain NA(Avagadro number) molecules we can called is as on mole molecules.

molecule	Molecular mass	Mass taken in g	Number of molecules	Number of moles
H_2	2	2	$6.022x10^{23}$	1
H_2SO_4	98	98	$6.022x10^{23}$	1
N_2	28	56	$2x6.022x10^{23}$	2
CO_2	44	220	$5x6.022x10^{23}$	5
NH_3	17	170	$10x6.022x10^{23}$	10

Eg: molecular mass of O_2 =32g

How many GMM are there in 64g oxygen?

How many molecules are present in it?

a)

$$GMM= \frac{GIVEN\ MAAS}{MOLECULAR\ MASS} = \frac{64g}{32g} = 2\ GMM$$

We know 1 GMM contain NA molecules.

So, 2 GMM contain $2x6.022x10^{23}$ molecules.

Relation between volume of a gas and moles:

Molar volume: one mole of any gas under the same condition of temperature and pressure will contain the same number of molecules and hence their volyme will also be the same. this is called molar volume.

At STP one mole of any gas will occupy a volume of 22.4L. this called molar volume at STP. (273K temperature and 1 atm pressure is known as standard temperature and pressure (STP)).

GAS	VOLUME
One mole of hydrogen at STP	22.4
1 mole of nitrogen at STP	22.4
2 mole of hydrogen at STP	44.8
.5 mole of nitrogen at STP	11.2

Eg: molecular mass of O_2= 32g

how many GMM are there in 64g oxygen?

Find the volume is needed to occupy it at STP?

$$GMM= \frac{GIVEN\ MASS}{MOLECULAR\ MASS} = \frac{64}{32} = 2GMM$$

we know number of moles of gas at STP = $\frac{VOLUME\ IN\ L\ at\ STP}{22.4}$

So, volume of L in STP= number of moles of gas at STP x 22.4 =2x22.4= 44.8