

Chapter-1Some basic concepts of chemistry

* Matter - Anything that occupies space and has mass is called matter.

Physical classification of matter

- Solid - Ex:- Chair, table, etc
- Liquid - Ex:- water
- Gas - Ex:- Air, Oxygen, etc.

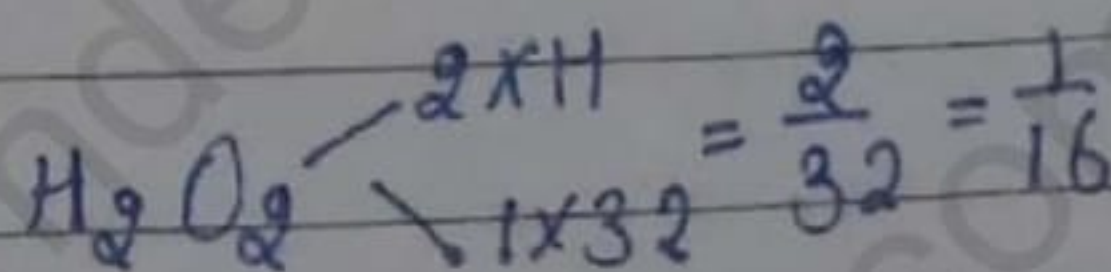
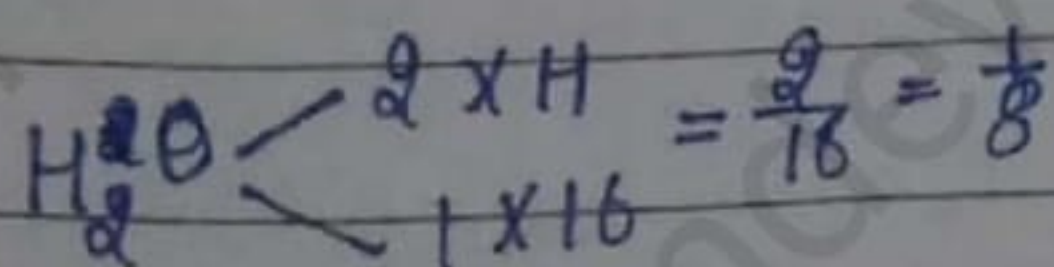
→ Chemical classification of matter1. Pure substance →

a) Element - It is the pure form of ^{matter} ~~water~~ which causes only one type of particles.

Ex:- C, H, O, Au, Ag, etc.

b) Compound - It is the pure form of matter which consist of two or more elements in a fixed ratio of mass

• The properties of compounds are completely different from its constituent element



2. Mixture :-

a.) Homogeneous mixture :- It is a mixture in which different compound produce only single phase

Ex:- Sugar + H₂O
C₂H₅OH + H₂O

b.) Heterogeneous mixture :- It is a mixture in which different compound produce more than one phase

Ex:- Oil + Water
Sand + Water

→ Difference between Homogeneous and Heterogeneous

1. It show only one phase	1. It show more than one phase.
2. Uniform composition throughout	2. Non-uniform composition throughout.
3. Ex:- Sugar solution, Salt solution	3. Ex:- Sand in water

* Precise and Accurate

→ Accurate :-

If the average value of measurement is equal to the actual value the measurement is said to be accurate

Actual value → 10

Average value → 10, 10.02, 9.98

→ Precise :-

If average value of different measurements is not equal to the actual value then the measurement is said to be precise

Actual value → 10

Precise → 9.0, 9.9, 9.0

* Rules for Significant figure

1. All non-zero digits are significant in nature

Ex:- 81437 → 5 sf
211 → 3 sf

2. Zero between non-zero are significant

Ex:- 80037 → 5 sf
201 → 3 sf

3. Initial zeroes or zero in the starting will not be significant

Ex:- 00087 → 2 sf ⇨ 00811 → 3 sf

4. Zeros in the end or right hand side are significant

Ex:- $3700 \rightarrow 4 \text{ sf}$

$1.81000 \rightarrow 6 \text{ sf}$

$1.0800 \rightarrow 5 \text{ sf}$

5. If any exact no. or a constant value is given there will be infinite significant figures

Ex:- $R = 8.314 \rightarrow \infty$

$G = 6.67 \times 10^{11} \rightarrow \infty$

$\pi = \frac{22}{7} \rightarrow \infty$

$6 \text{ marker (Exact no.)} \rightarrow \infty$

6. For non decimal digits first we have to convert in to scientific notation $\rightarrow N \times 10^n$ where the value of capital N is from 1 to 10

Ex:- 7200

7.2×10^2

4.201×10^6

3 sf

2. 0.020

2 sf

5. 0.004200

4 sf

3. 2.314

4 sf

6. 26001

5 sf

7. 180.0

9. $180 - 3sf$
 2

4sf

8. 130×10^7

$\frac{3}{2} sf$

★ $180 \rightarrow N \times 10^n$
 $\rightarrow 1.8 \times 10^2 \rightarrow 2sf$
 $\rightarrow 1.80 \times 10^2 \rightarrow 3sf$

★ 130×10^7
 $\rightarrow 1.3 \times 10^9 \rightarrow 2sf$
 $\rightarrow 1.30 \times 10^9 \rightarrow 3sf$

Q- 0.0010100
5sf

Rounding Off

- 1. $2.43 \rightarrow 2.4$
- 2. $2.26 \rightarrow 2.3$
- 3. $2.25 \rightarrow 2.2$
- 4. $2.35 \rightarrow 2.4$

→ If the digit is 4 and less than 4 there will be no addition of 1 during rounding off, In case of more than 5 we have to add while rounding off

→ In case of 5 if even no. is present there will be no addition but incase of odd no. we have to add 1 to make it even.

2.251 → 2.2
2.258 → 2.3

- 1. 0.01100 → 4sf
- 2. 0.8010 → 4sf
- 3. 1.090 → 4sf
- 4. 130 → $\frac{2}{3}$ sf

- Q
- 1. 8.352 → 8.4
 - 2. 8.350 → 8.4
 - 3. 8.450 → 8.4

Mathematical operation with significant figure

1. Addition and subtraction

The Result of Addition & subtraction must have the same no. of decimal place as present in value with least decimal place

Ex!-

$$\begin{array}{r} 4.11 \\ + 0.1 \\ \hline 4.21 \end{array} \rightarrow 4.2$$

Q- A vessel of 2.5 kg contains 1.22 g substance what will be sum of both?

$$\begin{array}{r}
 2.5 \\
 0.00122 \\
 \hline
 2.50122 \rightarrow 2.5
 \end{array}$$

1 kg = 1000g
1.22 → 0.00122g

2. Multiply and division

The result is rounded off to same number of significant figures as present in the value with least significant figures

Ex- $1.1 \times 1.1 = 1.21 \rightarrow 1.2$

Q-★ The solid has volume 1.23 cm^3 its mass plus mass of the weighing paper is 10.024 the paper has mass 0.03g. Calculate the density of the solid and find the significant no. also.

$$\begin{array}{r}
 1.23 \\
 10.024 - 0.03 \\
 = 9.994 \rightarrow 9.99 \\
 \hline
 9.994 \\
 1.23 \\
 \hline
 8.12 \text{ g/cm}^3
 \end{array}$$

H.W.

Q 16, 18, 19, 20

18. (i) $0.0048 \rightarrow 4.8 \times 10^{-3}$

(ii) $234,000 \rightarrow 2.34 \times 10^5$

(iii) $8008 \rightarrow 8.008 \times 10^3$

(iv) $500.0 = 5.000 \times 10^2$

(v) $6.0012 = 6.0012$

19. (i) $0.0025 \rightarrow 2 \text{ sf}$

(ii) $208 \rightarrow 3 \text{ sf}$

(iii) $5005 \rightarrow 4 \text{ sf}$

(iv) $126,000 \rightarrow 3 \text{ sf}$

(v) $500.0 \rightarrow 4 \text{ sf}$

(vi) $2.0034 \rightarrow 5 \text{ sf}$

20. (i) $34.216 \rightarrow 34.2$

(ii) $10.4107 \rightarrow 10.4$

(iii) $0.04597 \rightarrow 0.0460$

(iv) $2808 \rightarrow 2810$

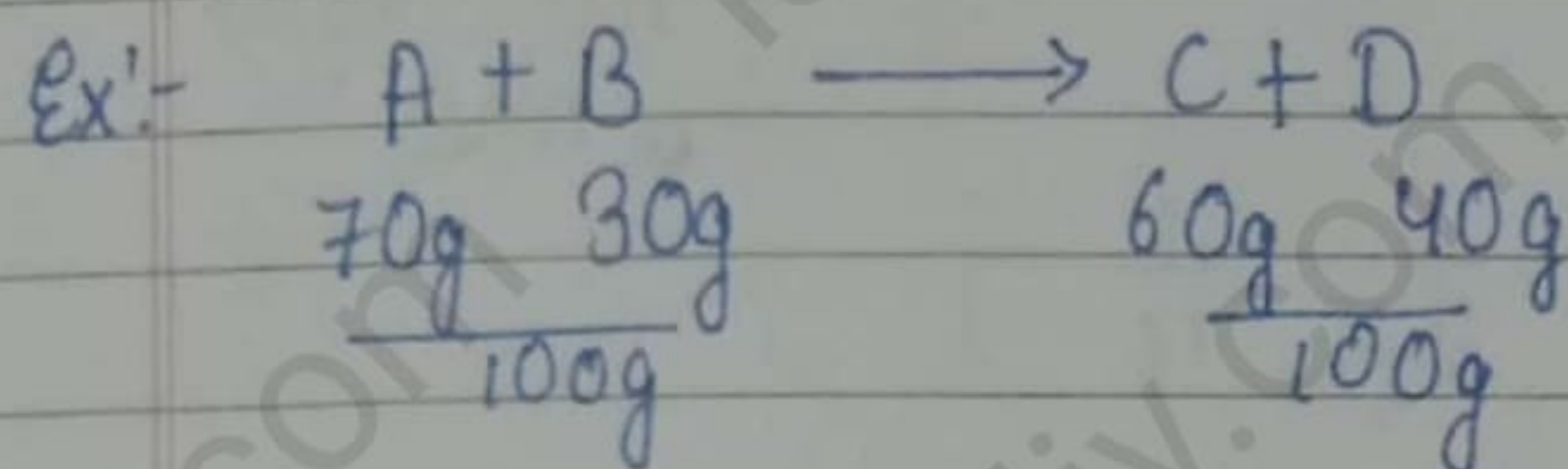
16. Significant figures are those meaningful digits that are known with certainty.

They indicate uncertainty in an experiment or calculated value.

For ex:- If 5.6 ml is the result of an experiment, then 5 is certain while 6 is uncertain, and the total no. Significant figures are 2.

1. Law of conservation of mass:-

According to this law the sum of the reactants is always equal to the sum of the product



Ques If ~~fall~~ calcium carbonate is decompose to form calcium oxide and CO_2

Data given

$$\text{Mass of } CaCO_3 = 100g$$

$$\text{Mass of } CO_2 = 44g$$

Calculate the mass of $CaO = ?$

$$CaCO_3 = 100$$

$$CO_2 = 44$$

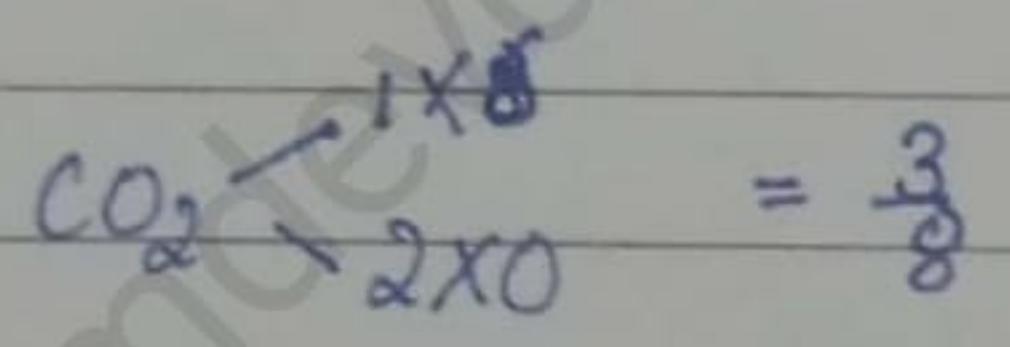
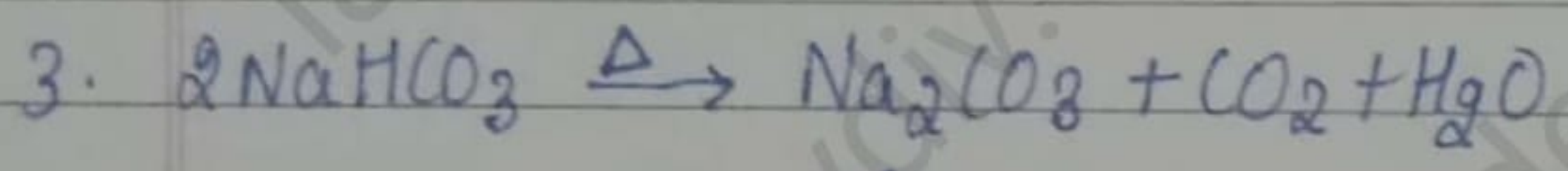
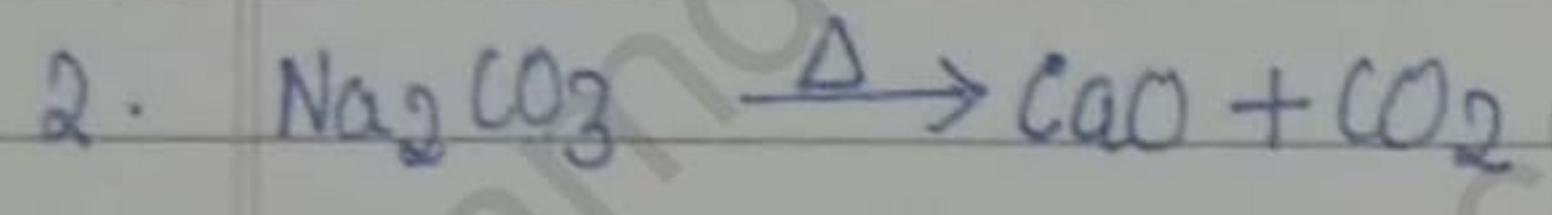
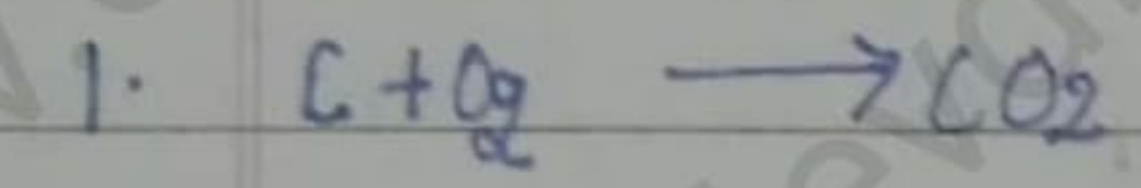
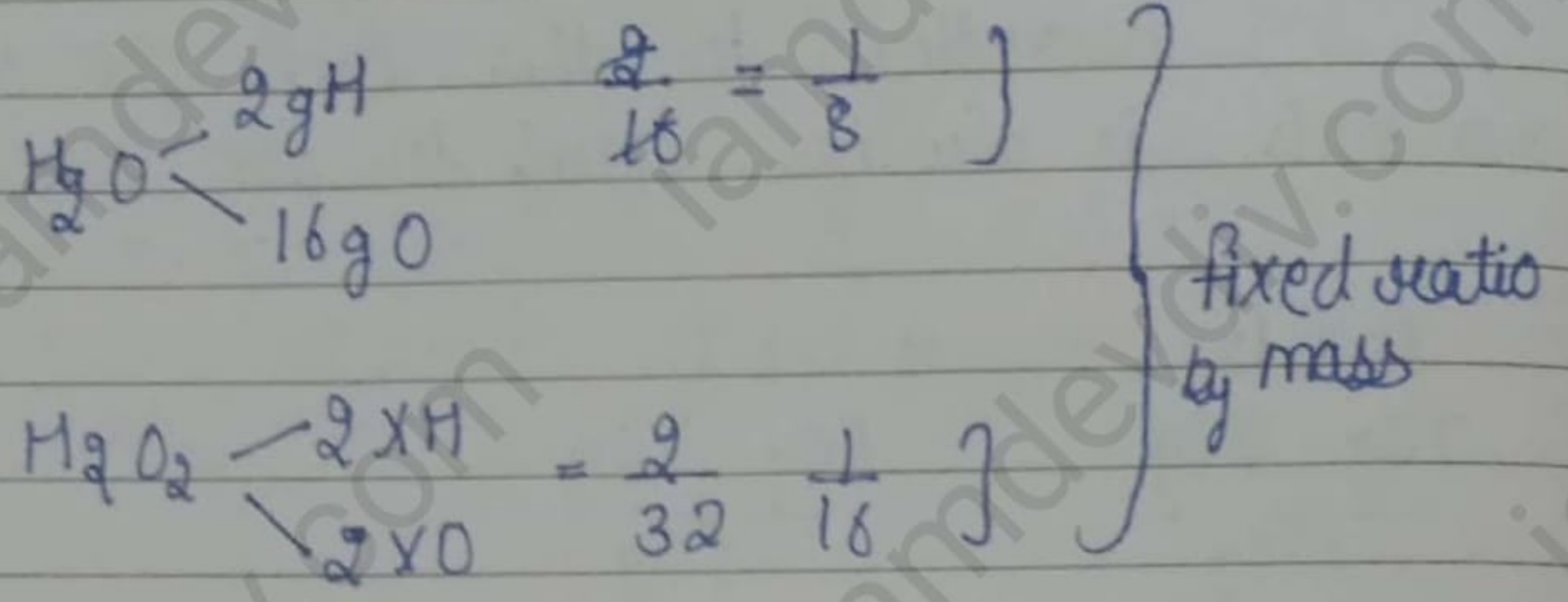
$$CaO = 100 - 44$$

$$= 56g$$

2. Law of definite ratio / proportion:-

According to this law a chemical compound is always made up of some constituent elements present in a fix ratio by mass

1. Sea
2. Pond
3. River



3. Law of multiple proportion or ratio:-

According to this law when two elements combine in different mass ratio several compounds will be formed. If the mass of element is given (fix) then the mass of another element will be a simple multiple ratio.

Ques - If N_2 and O_2 combine to form different compounds

Mass of N_2 (g)	Mass of O_2 (g)
Mass of O_2 $14 \times 2 = 28$	$16 \times 2 = 32$
$14 \times 2 = 28$	$32 \times 2 = 64$
28	$32 = 32$
28	$80 = 80$

$32 : 64 : 32 : 80$
 $2 : 4 : 2 : 10$

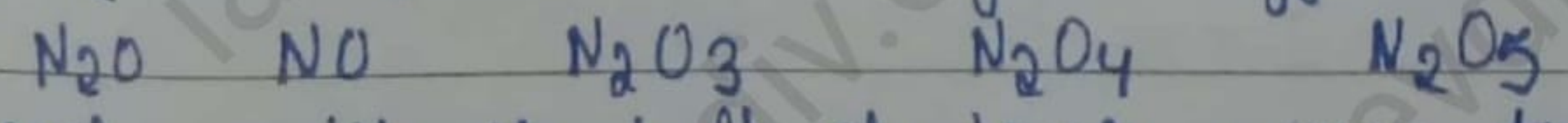
Ques - If two elements A and B combine to form different compounds

A	B
12 12	28
12	28
$12 \times 2 = 24$ / 2	$28 / 2 \rightarrow 14$
12	56

Which rule of chemical combination is followed by this data $\rightarrow 28 : 28 : 14 : 56$
 $2 : 2 : 1 : 4$

This data follows multiple proportion of data

Ques - If N_2 and O_2 combines to form different oxides



Verify with the help of atomic masses that this formation follows law of multiple proportion

	N	0
N_2	28	16
N	14×2	16×2
N_2	28	48
N_2	28	64
	28	80

$$16 : 32 : 48 : 64 : 80$$

$$1 : 2 : 3 : 4 : 5$$

Ques - Formation of SO_2 and SO_3 from Sulphur (S) and Oxygen.
 Does this formation follow law of multiple proportion.

	S	O
SO_2	32	32
SO_3	32	48

$$32 : 48$$

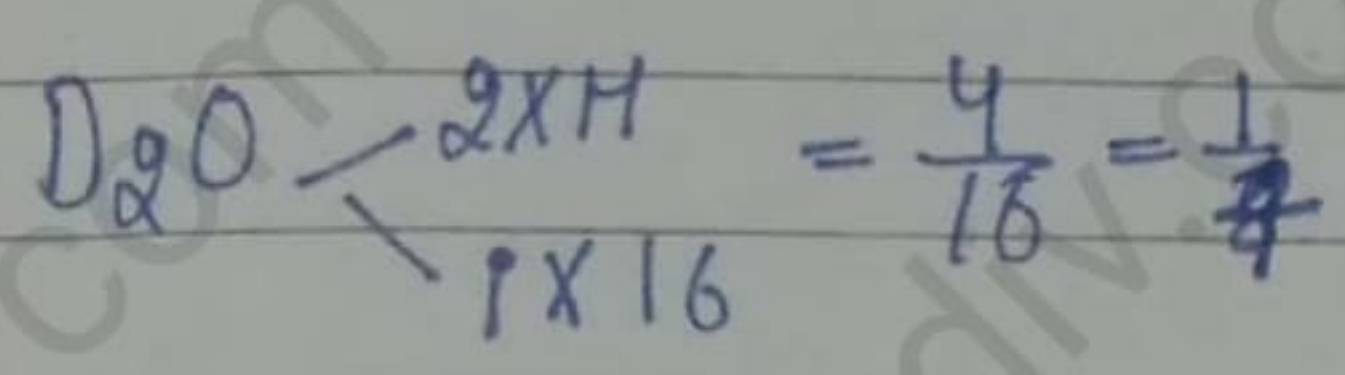
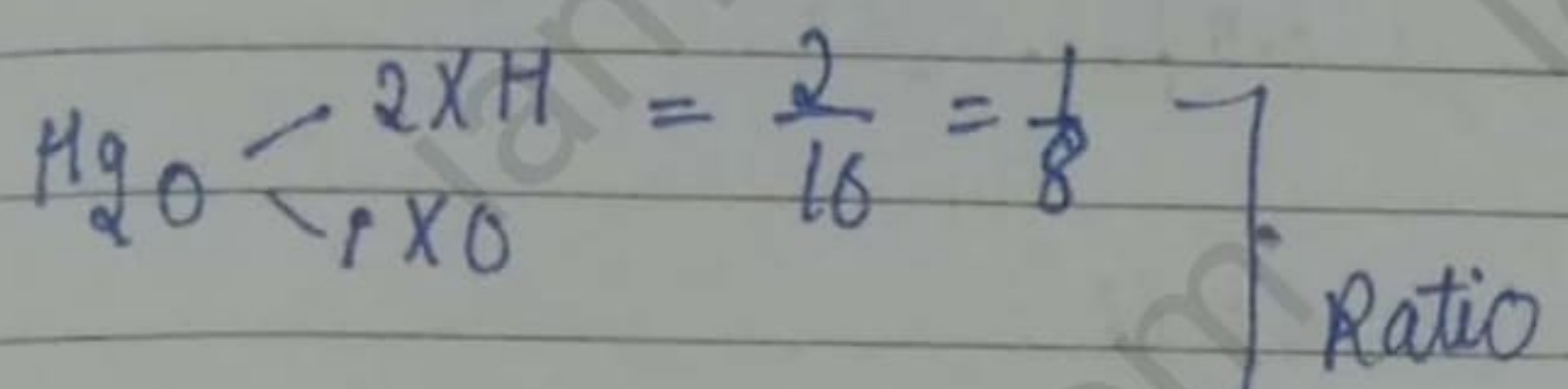
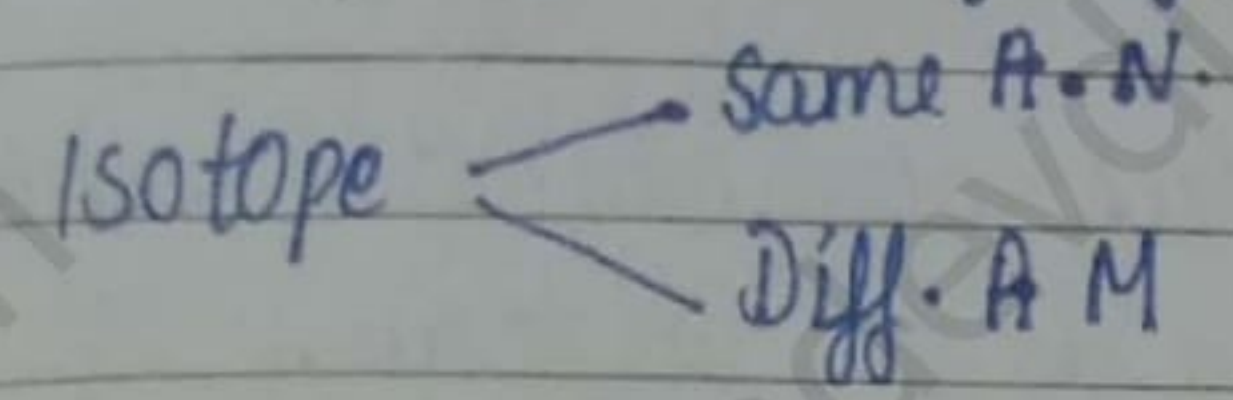
$$\boxed{2 : 3}$$

* Limitation of Law of Conservation of Mass

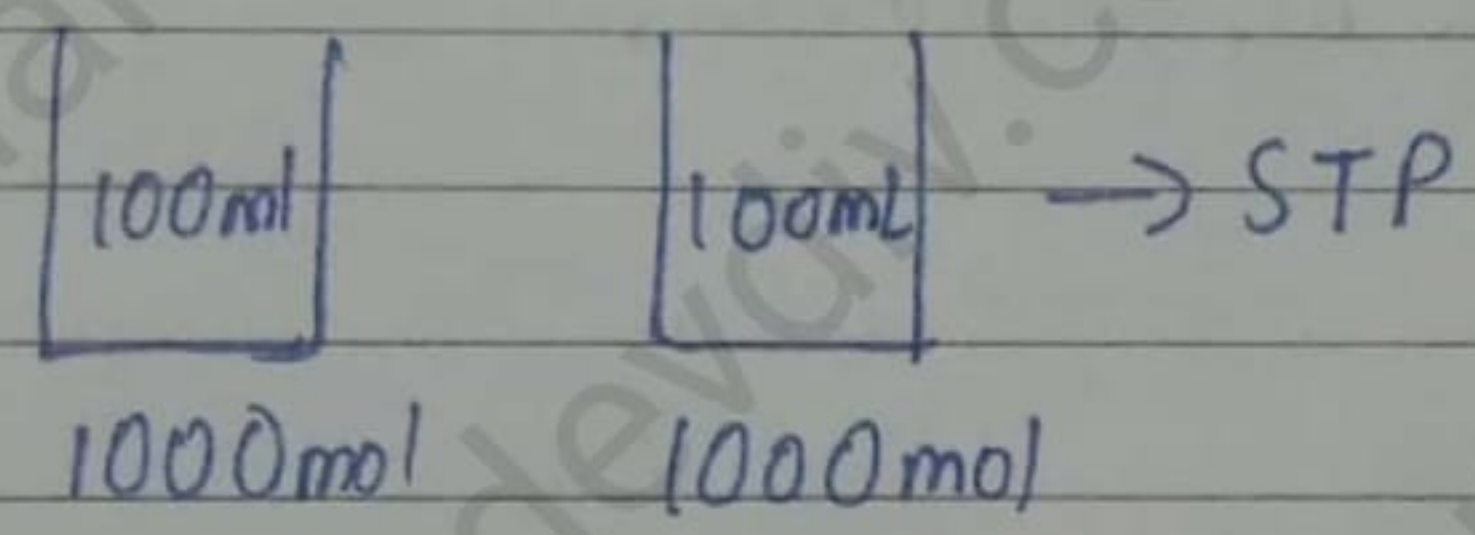
Nuclear reactions are the limitation of conservation of mass because here mass is converted into high amount of energy

$$E = mc^2$$

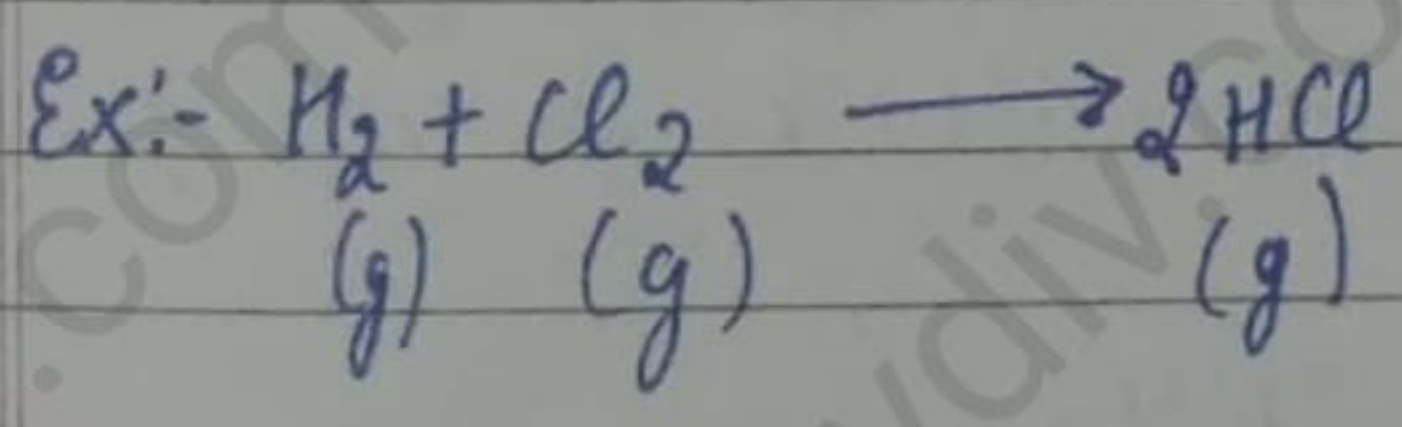
* Limitation of Law of definite Proportion



4. \rightarrow Avagadro's Law



According to this law equal volume of all gases contain equal no. of molecules at STP (standard temp. pressure)

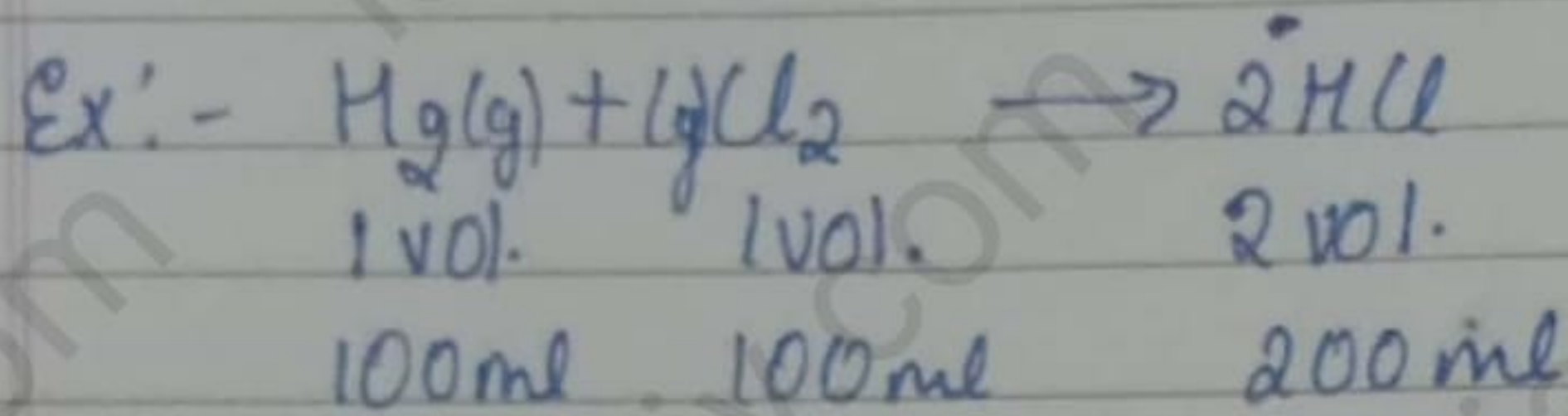


At STP

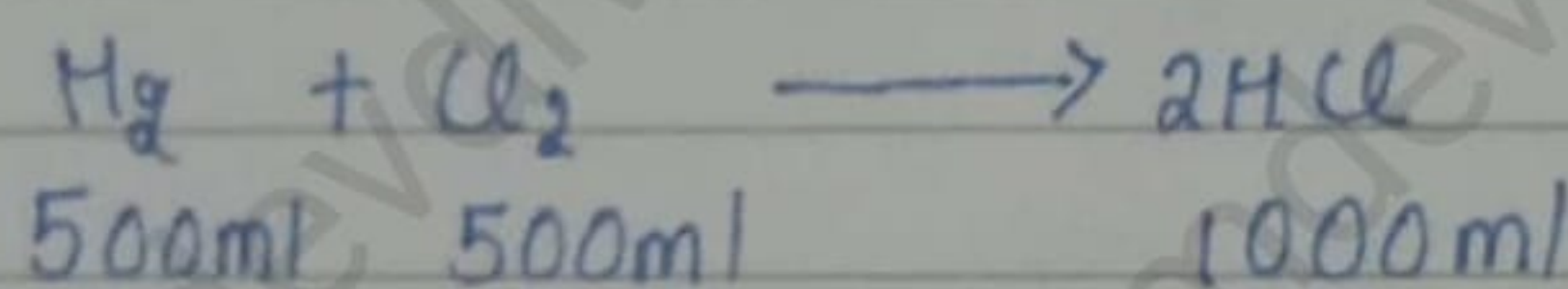
- 100 ml $\text{CH}_4(\text{g}) = Y \text{ mol.}$
- 200 ml $\text{CO}_2(\text{g}) = 2Y \text{ mol.}$
- 300 ml of $\text{CO}(\text{g}) = 3Y \text{ mol.}$
- 400 ml of $\text{O}_2(\text{g}) = 4Y \text{ mol}$
- 75 ml of $(\text{g}) = 0.75Y$

5 → Gay Lussac's Law:-

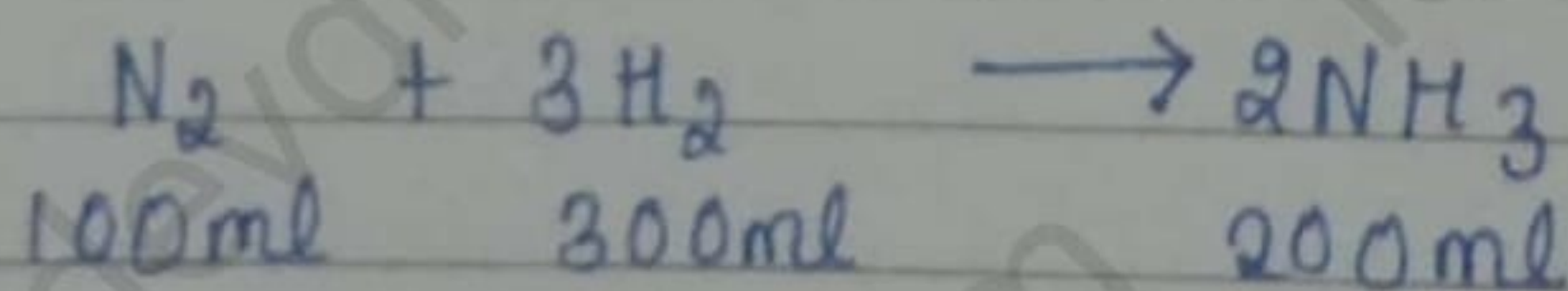
According to this law gaseous reactants combine to form gaseous products. They do so in terms of volume which will be a simple ratio.



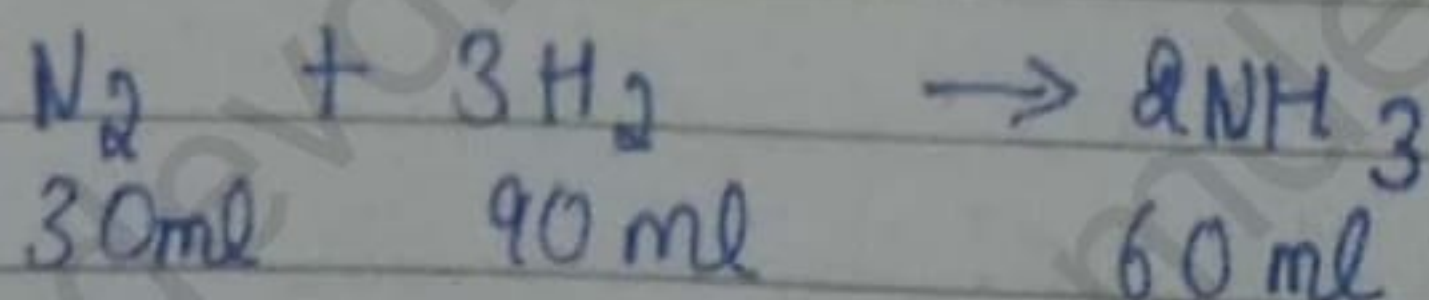
- Ques - If H_2 and Cl_2 reacts to form HCl gas and we have taken 500 ml H_2 . How much Cl_2 is required?
2. How much HCl will be formed?



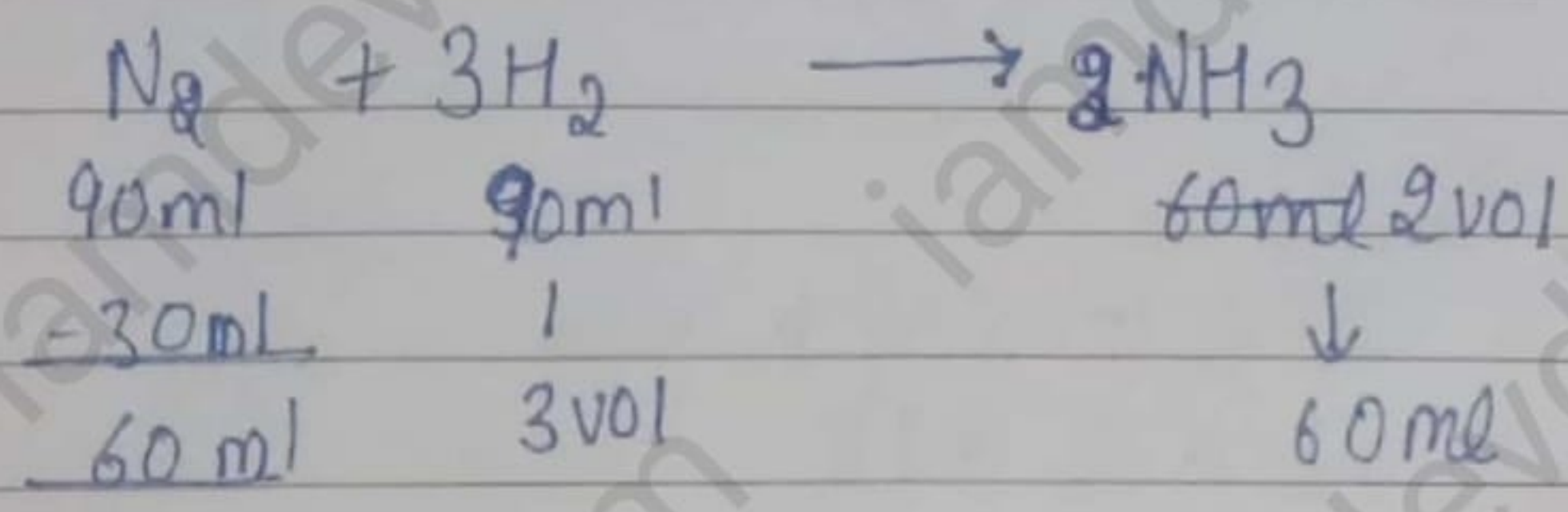
- Ques - If N_2 and H_2 reacts together to form NH_3 (Ammonia) if 100 ml N_2 is taken in the rxn how much H_2 will be required and how much NH_3 will be formed?



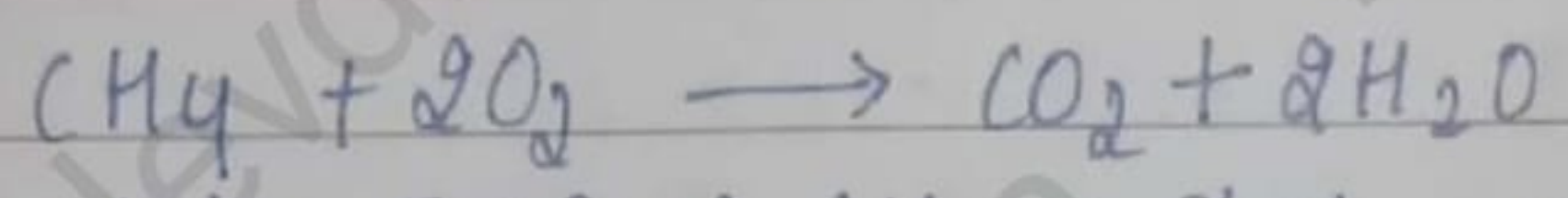
- Ques - If 90 ml H_2 is taken. How much N_2 is required



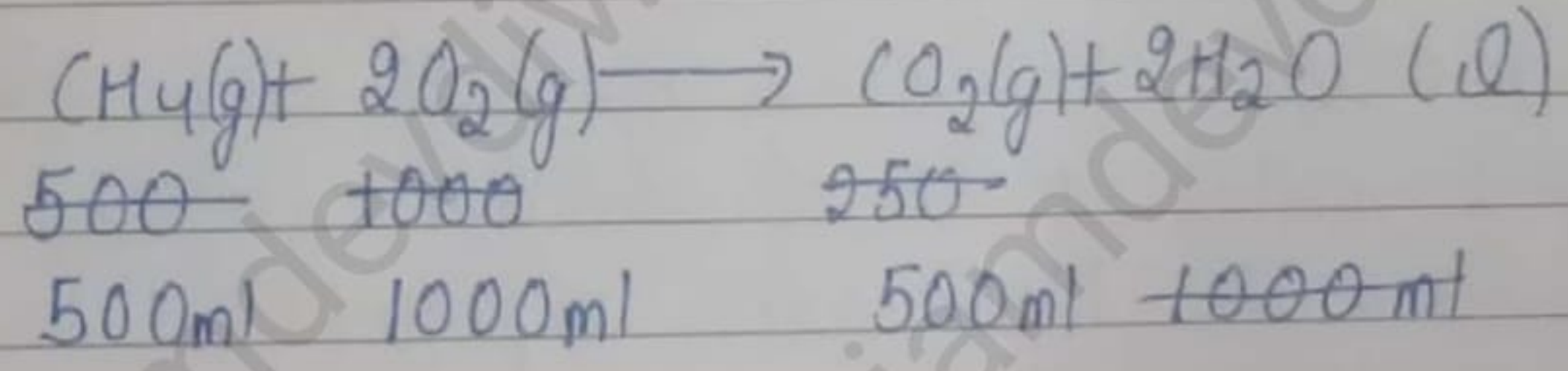
Ques If 90ml H_2 and 90ml N_2 are taken in a reaction vessel then what will be the resultant solution?



Ques - If the combustion of CH_4 is given in a simple reaction



If we have taken 500ml CH_4 what will be the volume of other reactant and the products?



→ Atomic mass:-

Atomic mass of any element is the average relative mass of its atom in comparison ~~it~~ with mass of ~~H₂~~ ~~C-12~~.

Ex:- Atomic mass of Oxygen is 16u.

→ Molecular mass:-

- Molecular mass of any substance is the average mass of its molecules in comparison to C-12 isotope.
- Molecular is the sum of atomic masses of elements present in a molecule it is obtained by multiplying the atomic mass of each element by the no. of its atoms and adding together.

$$\begin{aligned} \text{CH}_4 &\rightarrow 1 \times \text{C} - \text{Mass} + 4 \times \text{H} - \text{mass} \\ &= 1 \times 12 + 4 \times 1 \\ &= 16 \text{ u} \end{aligned}$$

$$\begin{aligned} \text{C}_6\text{H}_{12}\text{O}_6 & \\ &= 12 \times 6 + 1 \times 12 + 16 \times 6 \\ &= 72 + 12 + 96 \\ &= 180 \text{ u} \end{aligned}$$

$$\begin{aligned} \text{C}_{12}\text{H}_{22}\text{O}_{11} & \\ &= 12 \times 12 + 1 \times 22 + 16 \times 11 \\ &= 144 + 22 + 176 \\ &= 342 \text{ u} \end{aligned}$$

Formula mass: - Formula mass of any ionic compound is the mass of all ions present in one formula unit. (Only Ionic compound)

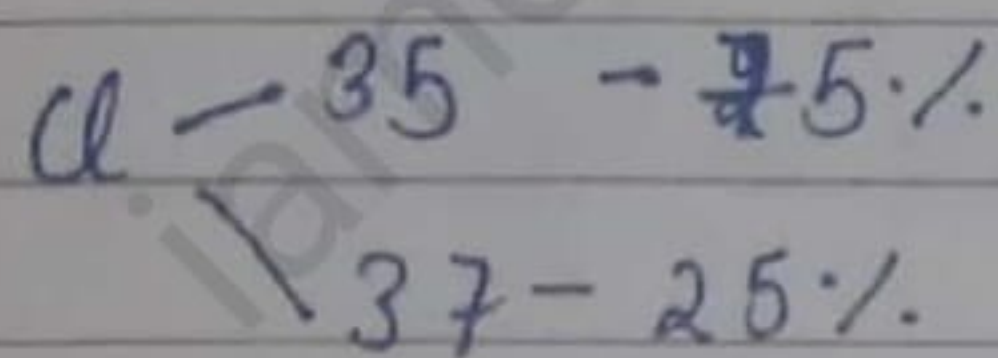
Formula mass of NaCl

$$\begin{aligned} \text{Na}^+ \text{Cl}^- &\rightarrow 23 + 35.5 \\ &\Rightarrow 58.5 \text{ u} \end{aligned}$$

$$\begin{aligned} \text{CaCl}_2 &\rightarrow 40 + 35.5 \times 2 \\ &111 \text{ u} \end{aligned}$$

→ Average Atomic Mass:-

$$\frac{\% \text{ Natural Abun.} \times \text{A.M. of that isotope} + \% \text{ Nat. Abun.} \times \text{A.M. of (2)}}{\% \text{ N (1+2)}}$$



$$\frac{75 \times 35 + 25 \times 37}{75 + 25}$$

$$= \frac{75 \times 35 + 25 \times 37}{75 + 25} = \boxed{35.5 \text{u}}$$

→ Gram Atomic Mass:-

It is the mass of any atom (element) expressed in grams.

Ex:- Atomic mass of C-Atom = 12u
Gram - - - - - = 12g

Atomic mass of N-Atom = 14u
Gram - - - - - = 14g

→ Gram molecular Mass:-

It is the mass of any molecule expressed in gram.

Ex:- Molecular mass of Ethyl Alcohol ($\text{C}_2\text{H}_5\text{OH}$) = $2 \times 12 + 5 \times 1 + 16$
= $24 + 5 + 16$
= 45u

→ Gram formula mass:-

It is the formula mass of ionic compounds expressed in grams.

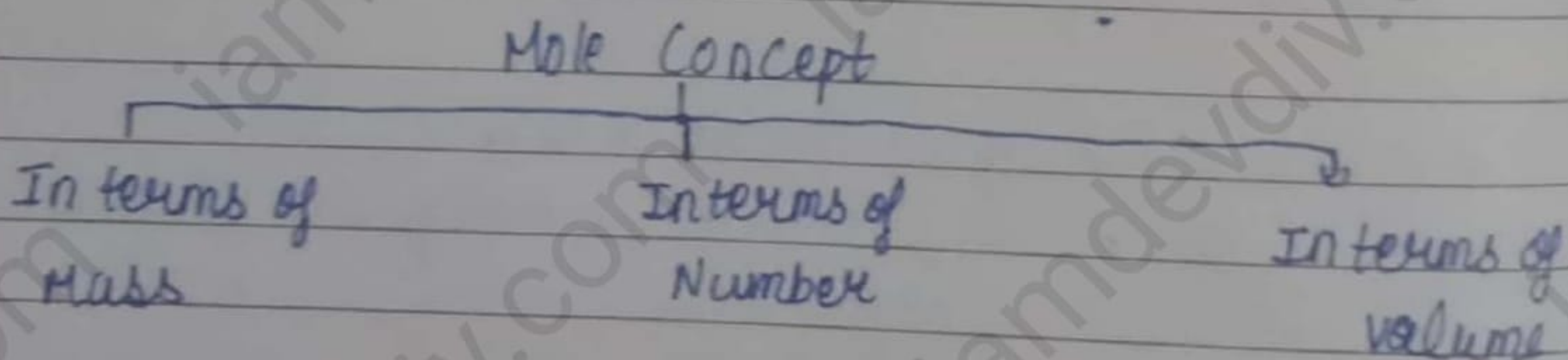
Ex:- Formula mass of NaCl = 58.5 u
Gram formula mass of NaCl = 58.5 g

• Formula mass of CaCl_2 = 111 u
Gram formula mass of CaCl_2 = 111 g

* Mole Concept

1 mole is the amount of substance which contains as many as particles or entities as there are atoms in exactly 12 g of C-12 isotope.

$$1 \text{ Mole} = 6.022 \times 10^{23} \text{ entity}$$



→ In terms of Mass:- A mole is defined as that amount of substance which has mass equal to gram atomic mass if the substance is molecular.

Ex:- 1 mole of C-Atom = 12 g
0.5 mole - - - - - $\frac{12}{2} = 6 \text{ g}$

1 mole of Na Atom = 23 g
1 mole of N-Atom = 14 g

1 mole of H_2O molecules \rightarrow 18g molecules
 1 mol of $C_{12}H_{22}O_{11}$ \rightarrow 342g molecules
 1 mol of C_2H_5OH \rightarrow 46g molecules

Q - 0.5 mole of water molecules contains

- a.) 27g molecules
- b.) 18g molecules
- c.) 36g molecules
- d.) None of the above

$$H_2O = 18g \text{ molecules}$$

$$= \frac{18g}{2}$$

\rightarrow In terms of Number: - A mole is defined as amount of substance which contains Avogadro no. $NA = 6.022 \times 10^{23}$ molecules of the substance. its atoms or molecules.

Ex:- 1 mol of C atom = 6.022×10^{23} atoms
 1 mol of H_2O molecules = 6.022×10^{23} molecules
 1 mol of Na (Sodium) = 6.022×10^{23}
 1 mol of NaCl = 6.022×10^{23} formula units of NaCl

OR

6.022×10^{23} of Na^+ ions
 6.022×10^{23} of Cl^- ions
 1 mol of $CaCl_2$ = 6.022×10^{23} formula units of $CaCl_2$
 6.022×10^{23} of Ca^{+2} ions Ca^{+2} $2Cl^-$
 12.044×10^{23} of Cl^- ions

→ In terms of volume:- In case of gases a mole is defined as that amount of gas which has the volume 22.4L at STP.

1 mole of oxygen gas = 22.4 Ltr. at STP

1 mole of CO_2 gas = 22.4 Ltr. at STP

0.5 mole of oxygen gas = 11.2 Ltr at STP

* Percentage Composition:- It is the ratio in which its constituent elements are present in given compound.

$\text{C}_6\text{H}_{12}\text{O}_6 \rightarrow$ Total mass 180

$$\% \text{ comp. of C} = \frac{\text{Mass of carbon} \times 100}{\text{Total mass}}$$

$$= \frac{6 \times 12}{180} \times 100$$

$$= \frac{72}{180} \times 100\%$$

$$= 40\%$$

$\% \text{ comp. of H} = 6.6\%$

Mass of H

$$= \frac{12}{180} \times 100$$

$$= \frac{20}{3} = 6.6\%$$

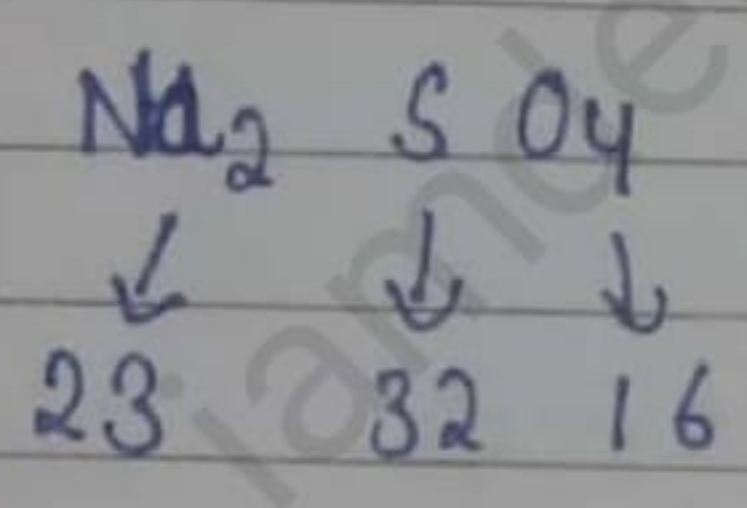
$\% \text{ comp. of oxygen}$

$$= 53.4$$

$$100 - (40 + 6.6)$$

$$= 53.4\%$$

Ques - Calculate the percentage composition of each element present in Na_2SO_4 ?



$$\% \text{ comp. of Na} = \frac{\text{Total mass of Na}}{\text{Total mass}} \times 100\%$$

$$= \frac{2 \times \text{Na-Mass}}{142} \times 100$$

$$\frac{46 \times 23}{142 \times 71} \times 100 = \frac{2300}{71} = 32.1\%$$

$$= \frac{3}{6} \times \frac{23}{142} \times 100 = \frac{2300}{71} = 32.1\%$$

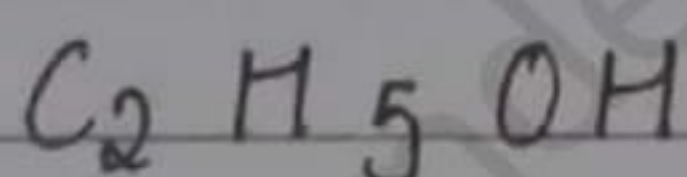
$$\% \text{ comp. of S} = \frac{\text{Mass of S}}{\text{Total mass}} \times 100$$

$$\frac{32 \times 16}{142 \times 71} \times 100 = \frac{1600}{71} = 22.5\%$$

$$\% \text{ comp. of Oxygen} = \frac{\text{Mass of O}}{\text{T. mass}} \times 100$$

$$= \frac{32}{142} \times 100 = \frac{42.5}{71} \times 100 = 3200 = 45.4\%$$

Ques - Calculate the percentage composition of each element present in ethanol and find element with least ^{compound}



$$\% \text{ composition of Carbon} = \frac{\text{Mass of C}}{\text{Total mass}} \times 100\%$$

$$= \frac{24}{46} \times 100 = \frac{24}{46} \times 100$$

$$= \frac{1200}{23} = \boxed{52\%}$$

$$\% \text{ composition of H} \rightarrow \frac{\text{Mass of H}}{\text{T. mass}} \times 100\%$$

$$= \frac{6}{46} \times 100 = \frac{300}{23} = 13.04\%$$

$$\boxed{= 13.13\%}$$

$$\% \text{ composition of O} \rightarrow \frac{\text{Mass of O}}{\text{T. mass}} \times 100\%$$

$$= \frac{16}{46} \times 100$$

$$= \frac{800}{23} = \boxed{34.8\%}$$

Element with least composition = Hydrogen

- Calculate -
- ① No. of atoms of Carbon = 1 mole of carbon = $2 \times 3 = 6$
 - ② No. of atoms of Hydrogen 1 mole of H = 6 atoms = $3 \times 6 = 18$ atoms
 - ③ No. of molecules in C_2H_6 molecules

Three moles of C_2H_6 contains -

$$1 \text{ mole of } C_2H_6 = 6.022 \times 10^{23} \text{ molecules}$$

$$3 \text{ mole of } C_2H_6 = 3 \times 6.022 \times 10^{23} \text{ molecules}$$

$$= 18.066 \times 10^{23} \text{ molecules}$$

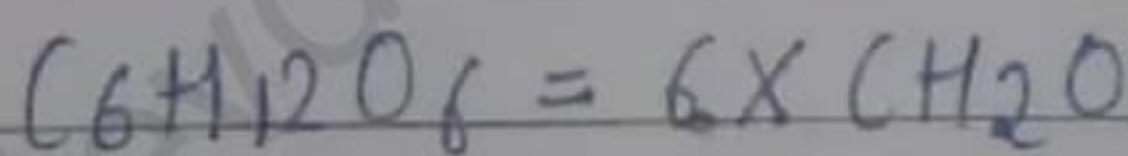
→ Empirical & Molecular formula

⇒ Molecular formula = It is the chemical formula which represent actual number of atoms of each element in a given compound.

Empirical formula - It is the chemical formula which represents simple ratio of no. of atoms of each element in a given compound.

Ex: - Mol. formula = $C_6H_{12}O_6$
Emp. formula = CH_2O

Relation -



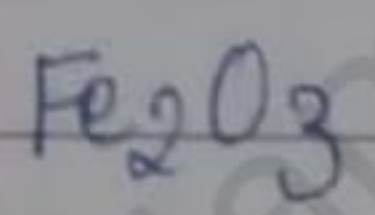
$$\text{Molecular formula} = n \times \text{Empirical formula}$$

$$\text{No. of moles} = \frac{\text{Given mass}}{\text{Molar mass}}$$

Ques- Empirical formula of an oxide of iron which has

69.9% iron (Fe)
30.1% O₂ by mass

Symbol	%mass	Atomic mass	no. of moles	Ratio	Simple Ratio
Fe	69.9	56	$\frac{69.9}{56} = 1.25$	$\frac{1.25}{1.25} = 1 \times 2$	2
O	30.1	16	$\frac{30.1}{16} = 1.88$	$\frac{1.88}{1.25} = 1.5 \times 2$	3



Ques- A welding gas contains Carbon & Hydrogen only. The mass percent of C is 92.33. Calculate the Empirical formula.

Symbol	%mass	Atomic mass	no. of moles	Ratio	Simple Ratio
C	92.33	12	$\frac{92.33}{12} = 7.69$	$\frac{7.69}{7.67} = 1$	1
H	7.67	1	$\frac{7.67}{1} = 7.67$	$\frac{7.67}{7.67} = 1$	1

Ques- A compound contains 4.07% H and 24.2% Carbon and 71.65% Chlorine if its molar mass is 98.96 g what is E. f. and calculate molar mass also?

Symbol	% mass	At. mass	No. of moles	ratio	E. form
H	4.07%	1	$\frac{4.07}{1} = 4.07$	$\frac{4.07}{2.01} = 2$	2
C	24.27%	12	$\frac{24.27}{12} = 2.0225$	$\frac{2.0225}{2.01} = 1$	1
Cl	71.65%	35.5	$\frac{71.65}{35.5} = 2.01$	$\frac{2.01}{2.01} = 1$	1

Empirical formula = CH_2Cl

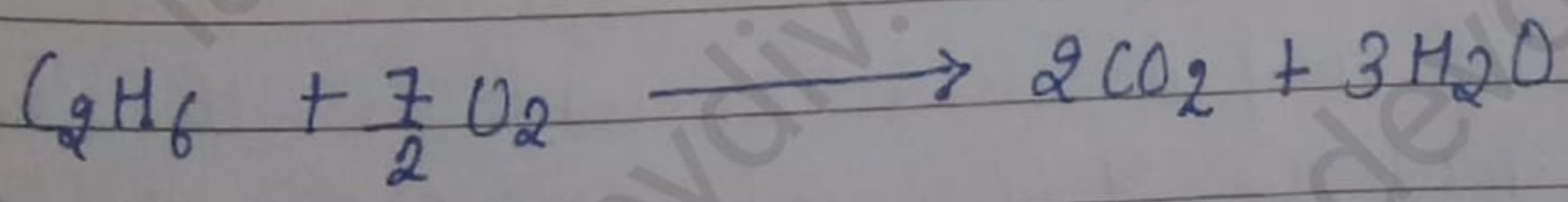
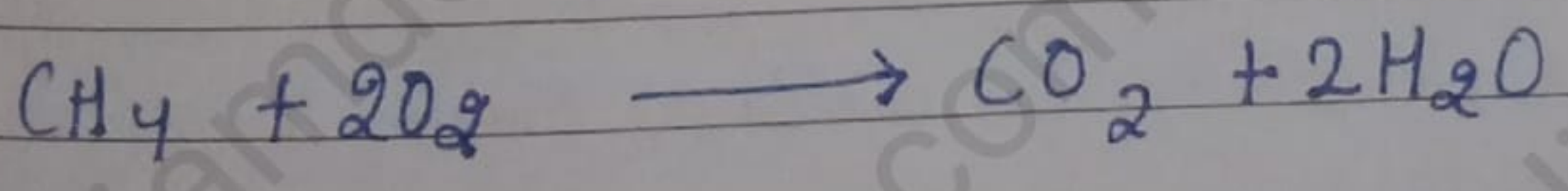
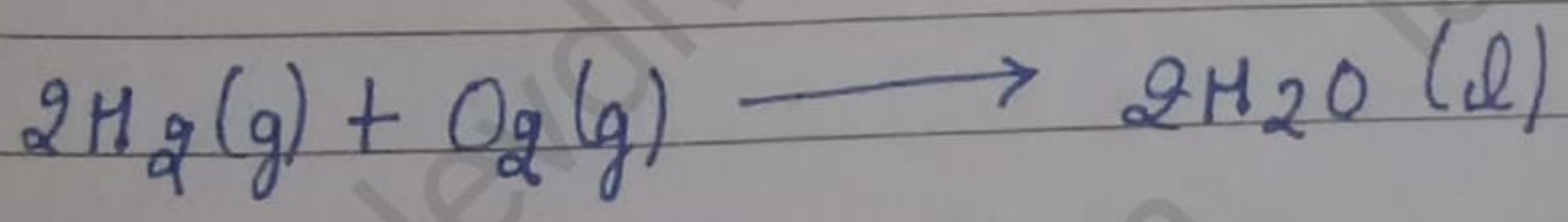
Molecular formula = $n \times$ empirical formula

$$\begin{aligned} \text{Molecular mass} &= [\text{CH}_2\text{Cl}] = 1 \times 12 + 2 \times 1 + 1 \times 35.5 \\ &= 1 \times 12 + 2 \times 1 + 1 \times 35.5 \\ &= 12 + 2 + 35.5 \\ &= 49.5 \text{ g} \end{aligned}$$

$$\frac{\text{Molar mass}}{\text{Emp. formula mass}} = \frac{98.96}{49.5} = 1.99 = 2 \text{ [app.]}$$

$$\begin{aligned} \text{Molecular formula} &= n \times \text{emp. formula} \\ &= 2 \times \text{CH}_2\text{Cl} \\ &= \text{C}_2\text{H}_4\text{Cl}_2 \end{aligned}$$

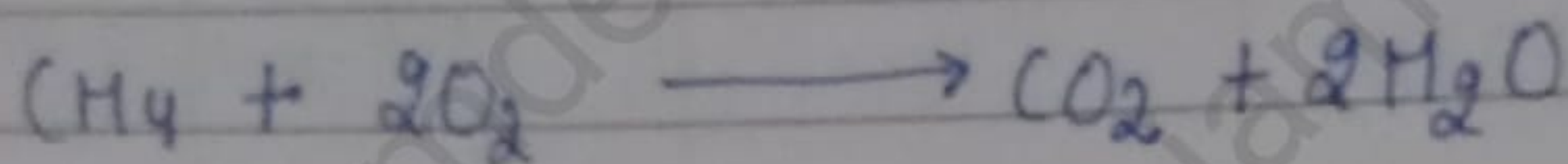
Ques Stoichiometry



→ Before calculation of the reaction we have to balance the given chemical equation because of law of conservation of mass or atoms.



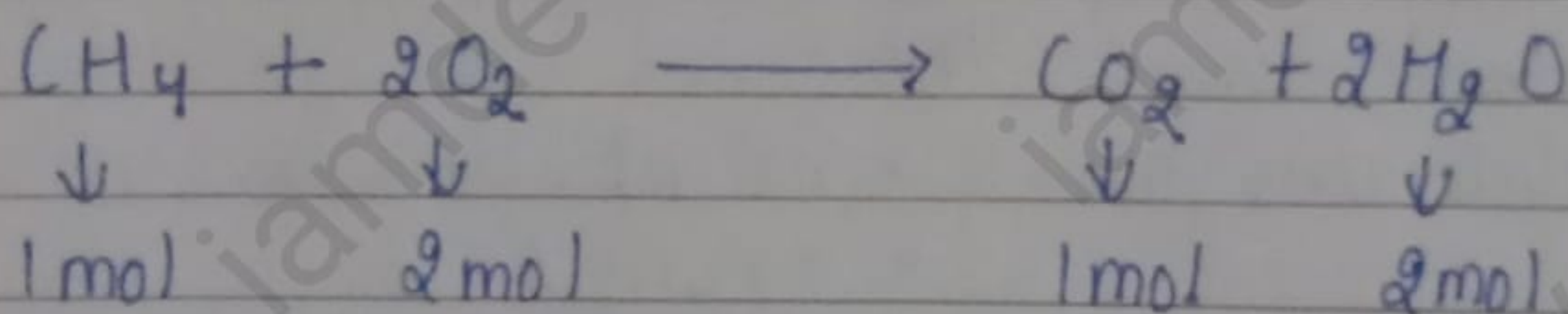
→ In terms of mass



- 16g methane reacts with 64g Oxygen to give 44g of CO_2 and 36g of H_2O

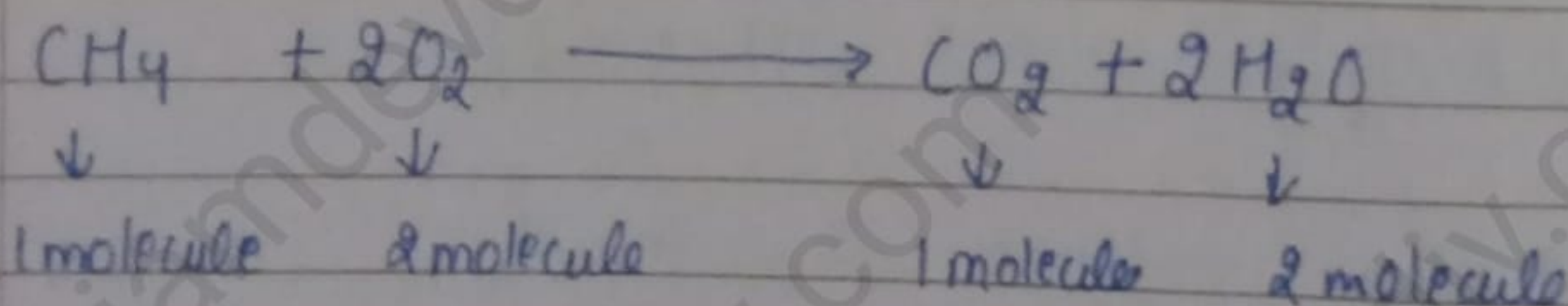
16g methane reacts with 64g Oxygen to give 44g of CO_2 and 36g of H_2O

→ In terms of mol



1 mole of CH_4 react with 2 mole of oxygen to give 1 mole of CO_2 and 2 mole of H_2O

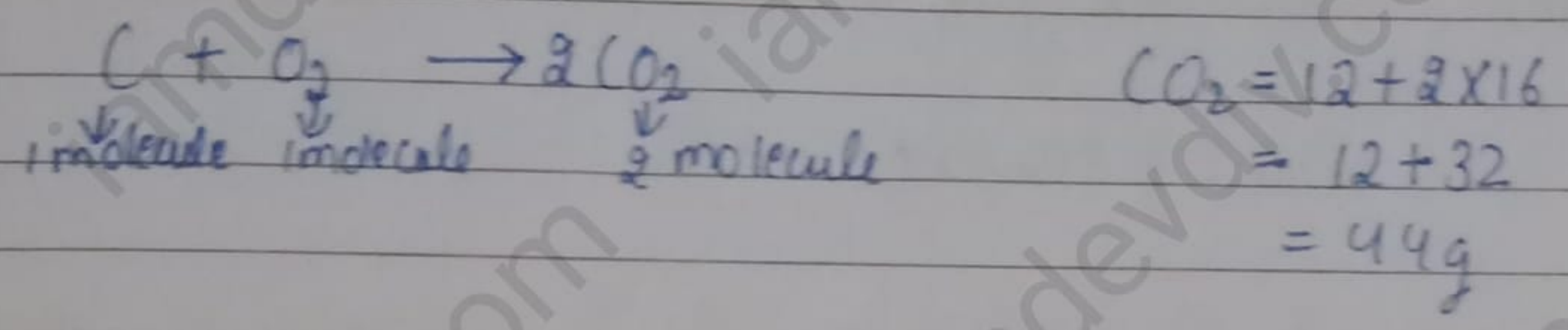
→ In terms of molecules



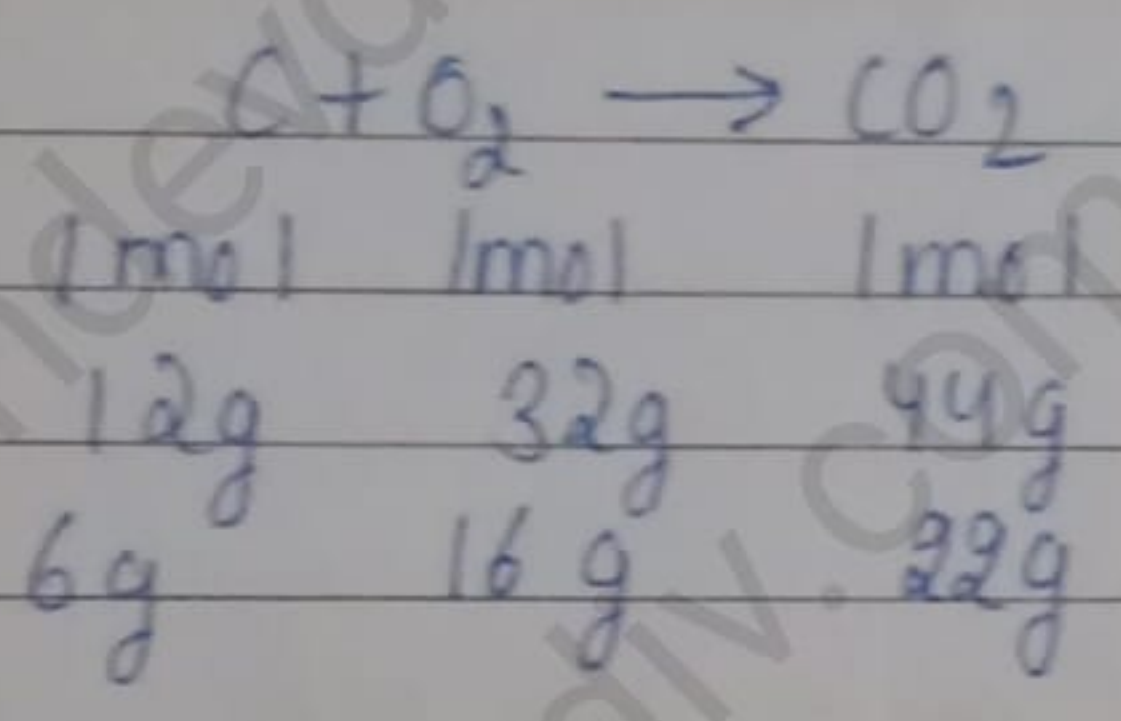
1 molecule of CH_4 is reacting with 2 molecules of O_2 to give 1 molecule of CO_2 and 2 molecules of H_2O

Ques - Calculate the amount of CO_2 that could be produced when

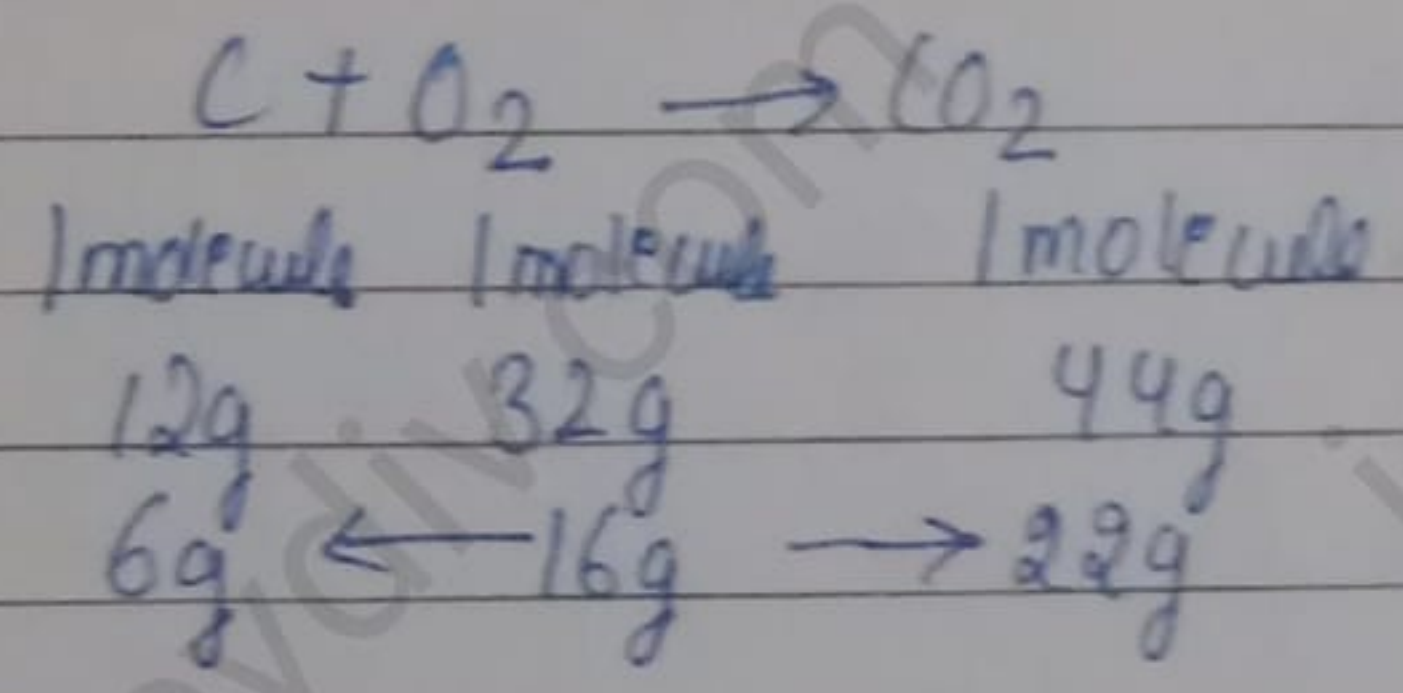
(i) 1 mol of C reacts with O_2 (Ox is burnt in air)



(ii) 1 mol of C is burnt in 16g O_2



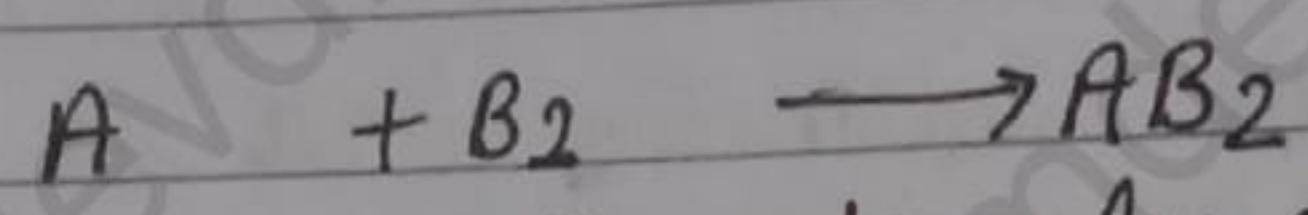
(iii) 2 moles of C are burnt in 16g O_2



Limiting reagent = O_2

Next
Ques 23

Identify the limiting ~~reagents~~ ^{reagents} if any in the following reactions



(A) 300 atoms of A + 200 molecules of B

Limiting Reagent \rightarrow B

(ii) 2 mole of A + 3 mole of B

Limiting Reagent \rightarrow A

(iii) 100 atoms of A + 100 molecules of B
No limiting Reagent present.

* Concentration of a Solution

• Concentration terms

- Mass %
- Mole fraction
- Molarity
- Molality

\rightarrow Mass % is the one way of expressive the concentration of an element in a compound or a component in a mixture.

$$\text{Mass\%} = \frac{\text{Mass of that compound}}{\text{Total Mass}} \times 100\%$$

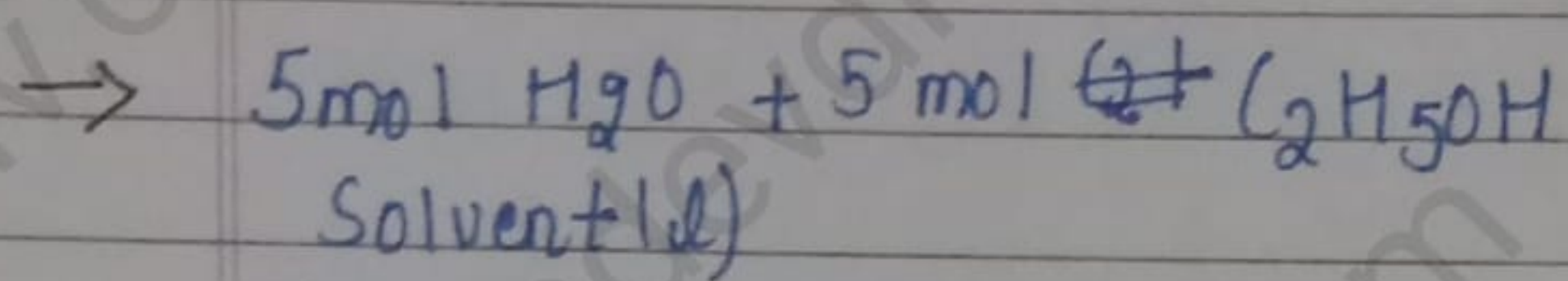
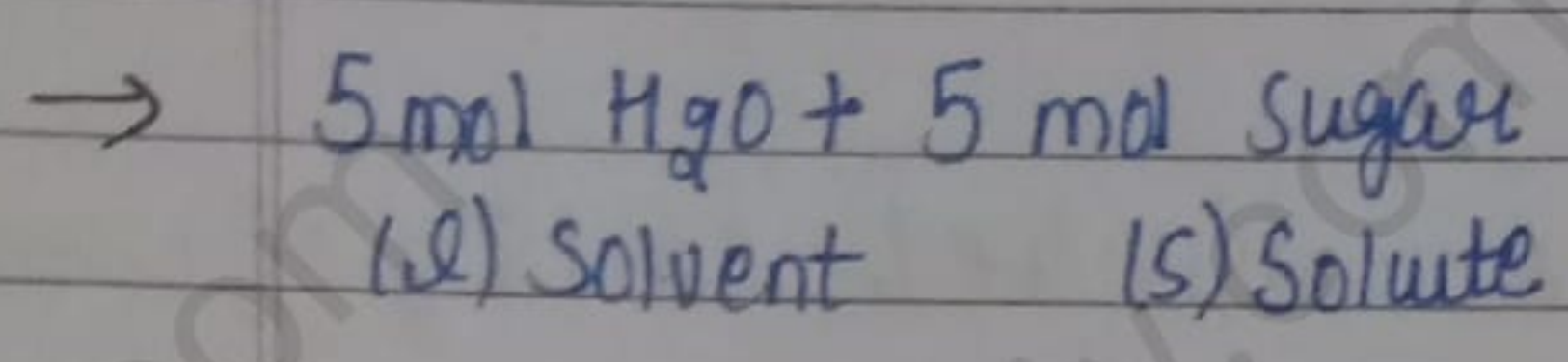
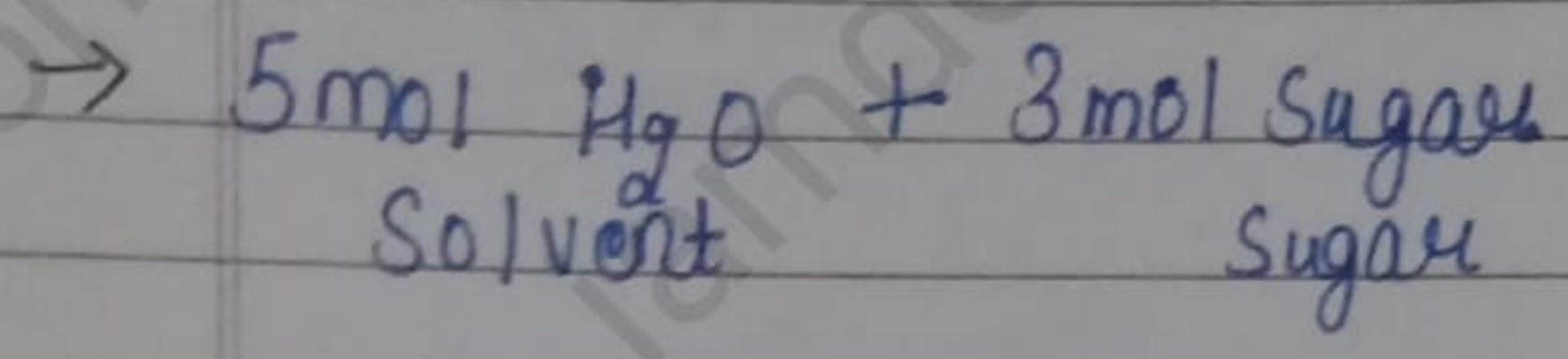
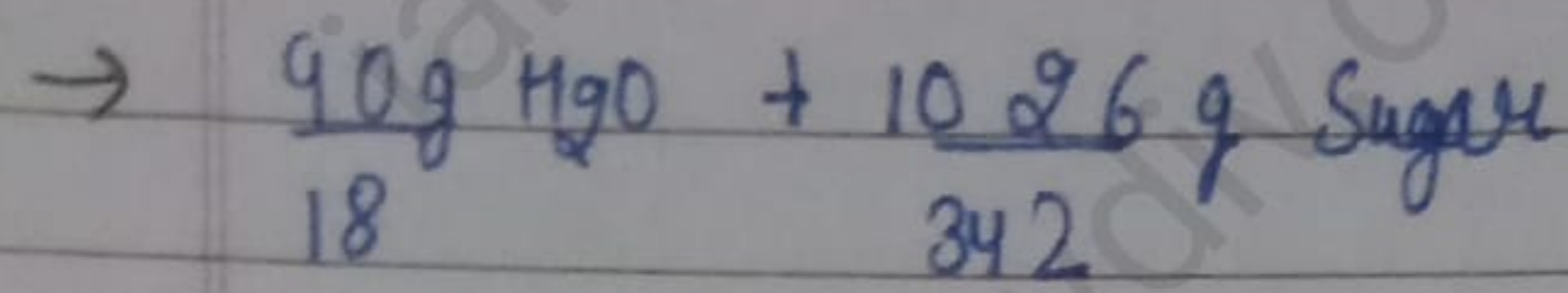
Ques- If 2 gram of substance A is dissolved in 18 g of water.
Calculate mass% of A

$$\frac{2}{20} \times 100\% \\ = 10\%$$

5% (w/w) - $\left\{ \begin{array}{l} \rightarrow \text{Solute} - 5\text{g} \\ \rightarrow \text{Solvent} = 95\text{g} \\ \rightarrow 100\text{g} - \text{Solution} \end{array} \right.$

5% (w/v) - $\left\{ \begin{array}{l} \rightarrow \text{Solute} - 5\text{g} \\ \rightarrow \text{Solvent} - x \\ \rightarrow \text{Solution} - 100\text{ml} \end{array} \right.$

5% (v/v) - $\left\{ \begin{array}{l} \rightarrow \text{Solute} - 5\text{ml} \\ \rightarrow \text{Solvent} - 95\text{ml} \\ \rightarrow \text{Solution} - 100\text{ml} \end{array} \right.$



• H₂O is universal solvent

* Mole fraction:-

Ratio of no. of moles of a particular component to the total no. of moles of solution is called Mole fraction.

A → solute

B → solvent

$$\text{Mole fraction of solute} = \frac{n_A}{n_A + n_B}$$

$$\text{,, solvent} = \frac{n_B}{n_A + n_B}$$

Ques- Calculate the mole fraction of solute when two moles of solute are dissolved in 3 moles of solution?

$$\text{Mole fraction of solute} = \frac{n_A}{n_A + n_B}$$

$$X_A = \frac{2}{2+3} \quad \text{--- (i)}$$
$$= \frac{2}{5}$$

(ii) Calculate the mole fraction of solvent also?

$$X_B = \frac{n_B}{n_A + n_B} \quad \text{--- (ii)}$$

Eq (i) and (ii)

$$X_A + X_B = \frac{n_A}{n_A + n_B} + \frac{n_B}{n_A + n_B}$$
$$= \frac{n_A + n_B}{n_A + n_B} \quad \text{--- (1)}$$

$$X_A + X_B = 1$$
$$X_B = 1 - X_A$$
$$= 1 - \frac{2}{5}$$

$$X_B = \frac{3}{5} \quad \text{(Ans)}$$

$$X_A = \frac{n_A}{n_A + n_B}$$
$$X_B = \frac{n_B}{n_A + n_B}$$

Eq 1 and Eq 2

$$X_A = \frac{n_A}{n_A + n_B}$$
$$X_B = \frac{n_B}{n_A + n_B}$$

* Molarity:-

Molarity is defined as no. of moles of solute per litre solution. It denoted by 'M'.

$$M = \frac{\text{no. of moles of solute}}{\text{Vol. of solution (in lit.)}}$$

$$M = \frac{\text{no. of moles of solute}}{\text{Vol. of solution (in ml)}} \times 1000$$

$$\frac{\text{No. of moles of solute} \times 1000}{\text{Mass of solution (g)}}$$

$$V = \frac{\text{Mass}}{\text{density}}$$

* Molality:- (m)

It is defined as no. of moles present in 1 kg of solvent.

$$m = \frac{\text{No. of moles of solute}}{\text{Mass of solvent (kg)}}$$

$$m = \frac{\text{No. of moles of solute} \times 1000}{\text{Mass of solvent (g)}}$$

$$m = \frac{\text{no. of moles of solute} \times 1000}{\text{mass of soln.} - \text{mass of solute (g)}}$$

Page No. _____
Date / / 20__

$$m = \frac{\text{no. of moles of solute} \times 1000}{\text{density of soln (g/ml)} \times \text{vol. of soln (ml)}} \text{ mass of solute (g)}$$

→ Effect of Temperature on Concentration Terms

The quantities which directly involves volume always changes with change in temperature.

- Mass % → $\frac{\text{Mass}}{\text{Soln (mass)}} \times 100$, no change
- Mole fraction → $\frac{n_1}{n_1 + n_2} (\text{soln}) \times 100$, no change
- Molarity → $\frac{n}{V (\text{soln})}$ → change
- Molality → $\frac{n}{\text{mass (solvent)}}$ → No change

(A) Molality is preferred over molarity

(R) Molality changes with change in temperature because it contains mass

Ans (C)

Page No. _____
Date / / 20__

Ques - Calculate the mass of Sodium acetate (CH_3COONa) required to make 500 ml of 0.375 molar solution molar mass of sodium acetate is 82 g/mol

$$\text{Molarity} = \frac{\text{no. of moles}}{\text{Vol. of soln (ml)}} \times 1000$$

$$0.375 = \frac{\text{Vol.} \times 1000}{82 \times 500}$$

$$W = 15.38 \text{ g}$$

$n = \frac{\text{mass}}{\text{molar mass}}$

Ques - 49g H_2SO_4 is present in 250 ml. of solution calculate molarity.

$$W = 49 \text{ g}$$

$$M = 98 \text{ g/mol}$$

$$V = 250 \text{ ml}$$

$$\text{Molarity} = ?$$

$$\text{Molarity} = \frac{\text{mass (W)} \times 1000}{\text{Molar mass} \times V(\text{ml})}$$

$$= \frac{49 \times 1000}{98 \times 250} = 2 \text{ M}$$

Ques Calculate the mole fraction of solute when 4% (w/w) NaOH soln is prepared in water?

4.1. (w/w)

→ solute → 4g → NaOH → 40 ⇒ $\frac{4}{40}$
 → solvent (100-4) = 96g → water = 18 ⇒ $\frac{96}{18}$
 → Soln → 100g

$$\chi_{NaOH} = \frac{\frac{4}{40}}{\frac{96}{18} + \frac{4}{40}} = \frac{\frac{1}{10}}{\frac{96}{18} + \frac{1}{10}}$$

$$= \frac{9}{489} = \frac{3}{163}$$

Q. from the above data calculate molality?

$$= \frac{4}{96} \times 1000$$

$$= \frac{0.1 \times 1000}{96} = \frac{500}{250} = \frac{12.5}{12}$$

$$= \frac{12.5}{12}$$

M = 1.41 (Ans)

Page No. _____
Date / / 20__

Ques - Calculate the Molarity of 4% (w/v) NaOH aq. Soln

$$\text{Mass of solute} = 4\text{g}/100 = \frac{4}{10}$$

$$\text{Sol}^n \text{ Vol} \rightarrow 100\text{ml}$$

$$M = \frac{\text{no. of moles of solute}}{\text{Vol. of sol}^n (\text{ml})} \times 1000$$

$$= \frac{4}{100} \times 1000$$

$$= 40$$

$$= 1\text{M}$$

→ Dalton's Atomic Theory

Postulates

1. Atom is indivisible and it is the smallest unit of matter.
2. All the atoms of same element are identical in all aspects. (Size, shape, etc.)
3. All the atoms of different element are different in all aspects.
4. Matter can neither be created nor be destroyed.
5. Atom can combine in different mass ratio it produces different compounds.

→ Limitations / Drawbacks

1. Atom can be further divided into sub atomic particles (electron, proton, neutron).

- 2. It cannot explain why atoms combine.
- 3. It cannot explain the nature of binding forces.
- 4. It ~~does~~ cannot explain why the atoms of different element are different in all aspect.

Ques- If 10 volumes of H_2 gas reacts with 5 volumes of O_2 gas
How many volumes of water vapour could be produced?

