7.10.24

TENDER HEART HIGH SCHOOL, SEC-33B, CHD

CLASS – VIII SUBJECT- CHEMISTRY

CHAPTER – 1 TEACHER- ANAMIKA

Good morning to all the students!

Students this lesson is for class-VIII for the subject of chemistry. Topic :- 'Chemical Equation' which is covered in chapter - 1. 'The Language of Chemistry' starting on page no-10 of your text-book titled - concise chemistry by 'selina publication' and is being submitted to you on 7, October, 2024

All students may now please open page no - 10 of your notebook in front of you.

If all students are ready. then let us start with this chapter. All students may now please listen carefully.

Chemical Equation :-

A chemical reaction can be represented using the symbols and formulae of the substances involved in it.
e.g - Carbon burns in air to form carbon dioxide.
This reaction can be written as

Carbon + Oxygen $\xrightarrow{heat}$ carbon dioxide

$C + O_2 \xrightarrow{Heat} CO_2$

Magnesium combines with nitrogen to form magne-sium nitride. It can be written as

$Mg + N_2 \longrightarrow Mg_3N_2$

Reactants Products

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[Substances taking part in the chemical reaction] [Substances formed as a result of the reaction.]

Chemical reactions may involve :-

(i) $PbCO_3 \rightarrow PbO + CO_2$
One reactant Two products
$2Cu(NO_3)_2 \rightarrow 2CuO + 4NO_2 + O_2$
One reactant Three products

(ii) $2H_2 + O_2 \rightarrow 2H_2O$
Two reactants One product
$NH_3 + HCl \rightarrow NH_4Cl$
Two reactants One product

(iii) $NaOH + HCl \rightarrow NaCl + H_2O$
$AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$
Two reactants Two products

(iv) $NH_4Cl + Ca(OH)_2 \rightarrow CaCl_2 + NH_3 + H_2O$
Two reactants Three products.

Students, Let us move on the next topic of this chapter which is 'Balanced Equation'.

Balanced Equation :-

Students we have already studied about a chemical equation. The elements of reactant molecules are also present in the product molecules. Or balance equation is that in which the total number of atoms of each element in the reactants is the same as the number of atoms in the

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products formed. e.g - $C + O_2 \rightarrow CO_2$
Here number of carbon atoms on both side is 1, and number of oxygen atoms on both side is 2. So the equation is balanced. Now see another example

$N_2 + H_2 \rightarrow NH_3$ (This equation is not balanced)
$N=2, H=2 \rightarrow N=1, H=3$
$N_2 + 3H_2 \rightarrow 2NH_3$
$N=2, H=(3\times2)=6 \rightarrow N=2, H=(2\times3)=6$ (Now balanced)

Balancing a Chemical Equation

We will learn to balance an equation by using hit and trial method. We do this by making the atoms of each element equal on both sides of equation.

STEPS:-

1) Count the number of times an element occurs on either side.
2) The element with the least frequency is balanced first.
3) When two or more elements have the same frequency, the metallic element is balanced first.

Let us balance some equations.

1. $Fe + H_2O \rightarrow Fe_3O_4 + H_2$

Element	Reactant side	Product side
Fe	1	3
H	2	2
O	1	4

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Fe and H same frequency 4, but Fe is metal so it will balanced first. Write 3 before Fe, on reactant side. Now Fe = 3 (on both sides)

$3Fe + H_2O \rightarrow Fe_3O_4 + H_2$

As H = 2 on both sides, let us balance O. On the product side O = 4 so we will multiply H_2O on the reactant side with 4

$3Fe + 4H_2O \rightarrow Fe_3O_4 + H_2$

Now, Fe = 3 Fe = 3
O = 4 O = 4
H = (4 X 2) = 8 H = 2

To equalise H on the product side multiply by 4.

$3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$ (Balanced)

2. $HNO_3 + H_2S \rightarrow NO_2 + H_2O + S$

H = 1 + 2 = 3 H = 2
N = 1 N = 1
O = 3 O = 2 + 1 = 3
S = 1 S = 1

Multiply HNO_3 with 2, to make H = 4 on reactant side and multiply H_2O with 2, to make H = 4 on product side.

$2HNO_3 + H_2S \rightarrow NO_2 + 2H_2O + S$

N = 2 N = 1

Multiply NO_2 with 2, to equalize N on both sides

$2HNO_3 + H_2S \rightarrow 2NO_2 + 2H_2O + S$

Now, H = 4 H = 4 [Balanced]
N = 2 N = 2
O = 2 X 3 = 6 O = (2 X 2) + 2 = 6
S = 1 S = 1

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3. $P + HNO_3 \rightarrow NO_2 + H_2O + H_3PO_4$

P=1	P=1
N=1	N=1
H=1	H=5
O=3	O=7

P and N are already equal, so next lower frequency is of H. To equalize H, multiply HNO_3 with 5. Now H=5 on both sides.

$P + 5HNO_3 \rightarrow NO_2 + H_2O + H_3PO_4$

Now, P=1	P=1
N=5	N=1
H=5	H=5
O=15(5x3)	O=7

Multiply NO_2 with 5 to equalize N.

$P + 5HNO_3 \rightarrow 5NO_2 + H_2O + H_3PO_4$

Now check, P=1	P=1	[Balanced]
H=5	H=5	
N=5	N=5	
O=15	O=(5x2)+1+4=15	

4. $Pb_3O_4 + HCl \rightarrow PbCl_2 + H_2O + Cl_2$

Pb=3	Pb=1
H=1	H=2
Cl=1	Cl=4
O=4	O=1

To make Pb=3 on reactant side, multiply $PbCl_2$ with 3.

$Pb_3O_4 + HCl \rightarrow 3PbCl_2 + H_2O + Cl_2$

Now, Pb=3	Pb=3	
H=1	H=2	
Cl=1 & O=4	Cl=(3x2)+2=8, O=1	(P.T.O.)

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If we multiply HCl with 8, Cl will become 8 on both the sides

$Pb_3O_4 + 8HCl \rightarrow 3PbCl_2 + H_2O + Cl_2$

Now, multiply H_2O on the product side by 4 so that H=8 on both the sides.

Now, $Pb_3O_4 + 8HCl \rightarrow 3PbCl_2 + 4H_2O + Cl_2$

Pb=3	$Pb_3O_4 + 6HCl \rightarrow 3PbCl_2$	Pb=3 (Balanced)
O=4	$+3H_2O$	O=4
H=8	$+Cl_2$	H=8
Cl=8		Cl=8

When there are many elements in an equation, start balacing with the atoms of lower frequency, the elements with higher frequency get balanced automatically.

Now, let us discuss the next topic of this chapter which is 'Information conveyed by a balanced chemical equation'

Information conveyed by a balanced chemical equation.

Look at the following balanced equation.

$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$

Sodium hydroxide — sulphuric acid — sodium sulphate — water

The above equation tells us,

1. about the reactants and products formed in the reaction.
2. The number of molecules of all the substances involved like here we can see, 2 molecules of sodium

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hydroxide react with 1 molecule of sulphuric acid to give 1 molecule of sodium sulphate and 2 molecules of water.

3. Chemical composition of each compound like, sodium sulphate (Na_2SO_4) contains 2 atoms of sodium, one atom of sulphur and 4 atoms of oxygen.

4. Every atom has a fixed mass called as atomic mass. When we add the atomic masses of all the elements of a molecule we get the molecular mass.

A balanced equation will tell us molecular mass of reactants and products formed. In a balanced equation, Mass of reactants = Mass of Products

Atomic mass of Na = 23, O = 16, H = 1, S = 32,

$$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$$

$$2(23+16+1) + 1\times2+32+16\times4 \rightarrow 2\times23+32+16\times4+2(1\times2+16)$$

$$2\times40 + 98 \rightarrow 142 + 36$$

$$178 = 178$$

Mass of reactants = Mass of products

It proves the law of conservation of mass.

Let us take one more example:

$$Zn + 2KOH \rightarrow K_2ZnO_2 + H_2$$

Zinc — Potassium hydroxide — Potassium zincate — Hydrogen

Information conveyed by the above equation.

1) One atom of zinc reacts with 2 molecules of potassium hydroxide to give one molecule of potassium zincate and one molecule of hydrogen.

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2) Atomic mass of Zn=65, K=39, O=16, H=1

$Zn + 2KOH \rightarrow K_2ZnO_2 + H_2$

$65 + 2(39+16+1) \rightarrow 39\times2+65+16\times2 + 1\times2$

$= 65 + 112 \rightarrow 175 + 2$

65g of Zinc reacts with 112g of potassium hydroxide give 175g of potassium zincate and 2g of hydrogen

3) The mass of reactants = The mass of products

177g = 177g

Limitation of a chemical equation :-

A chemical equation cannot tell us

1) The reactant and products are solid, liquid or gas.
2) The speed of the reaction (slow rate or fast rate)
3) Time taken for completion of the reaction
4) During the reaction heat was released or absorbed
5) The reaction is reversible or irreversible.
6) The reaction is completed or is incomplete.

Making chemical Equation more informative :-

We can make a chemical equation more informative by writing the temperature, pressure, catalyst etc, above or below the arrow (→) seperating reactants and products. Let us see in examples :-

1. $N_2 + 3H_2 \xrightarrow[450^\circ C]{Fe+Mo} 2NH_3$

Nitrogen Hyd 200-900atm Ammonia
-rogen

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Date

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Fe → catalyst, Molybdenum (Mo) → Promoter
Temperature required = 450°C, Pressure → 200 to 900 Atmosphere

2. $NH_4Cl \rightleftharpoons NH_3\uparrow + HCl\uparrow$
Ammonium chloride — Reversible reaction — Ammonia — Hydrogen chloride gas (upward arrow for gas)

3. $CaCO_3 \xrightarrow{\Delta} CaO + CO_2$
Calcium carbonate — Calcium oxide — Carbon dioxide
Δ → Symbol for heat, Calcium carbonate decompo-ses on heating

4. $Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$
Zn (s) → solid state; HCl (aq) → Aqueous state (Dissolved in water); $ZnCl_2$ (aq) → Aqueous state; H_2 (g) → Gaseous state

5. $C(s) + O_2(g) \rightarrow CO_2(g) + Heat$ (Exothermic reaction)
$2C(s) + O_2(g) \rightarrow 2CO(g) - Heat$ (Endothermic reaction)
Dilute acid → Acid with more water in it.
Concentrated acid → Acid with less water in it.

6. $Zn(s) + dil.2HCl \rightarrow ZnCl_2(aq) + H_2(g)$
Zinc powder — dilute hydrochloric acid — aq. Zinc chloride — Hydrogen gas

7. $Zn(s) + Conc.2H_2SO_4 \rightarrow ZnSO_4(aq) + 2H_2O(l) + SO_2(g)$
Zinc powder — concentrated sulphuric acid — Aqueous Zinc sulphate — Water (liquid) — sulphur dioxide gas

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8. $AgNO_3(aq) + HCl(aq) \rightarrow HNO_3(aq) + AgCl\downarrow$
Downward arrow (↓) is for precipitate white precipitate

Let us solve some word equations given on page - 19

(a) Sodium hydroxide + Sulphuric acid → Sodium sulphate + water
$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$

(b) Potassium bicarbonate + sulphuric acid → Potassium sulphate + carbondioxide + water
$2KHCO_3 + H_2SO_4 \rightarrow K_2SO_4 + 2CO_2 + 2H_2O$

(c) Iron + sulphuric acid → Ferrous sulphate + hydrogen
$Fe + H_2SO_4 \rightarrow FeSO_4 + H_2$

(d) Chlorine + Sulphur dioxide + water → sulphuric acid + hydrogen chloride
$Cl_2 + SO_2 + 2H_2O \longrightarrow H_2SO_4 + 2HCl$

(e) Silver nitrate → Silver + nitrogen dioxide + water
$2AgNO_3 \rightarrow 2Ag + 2NO_2 + O_2$

(f) Copper + nitric acid → Copper nitrate + nitric oxide + water
$3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$

(g) Ammonia + oxygen → nitric oxide + water
$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$

Now, I will give you three a very short questions. You will get a three minutes break to write the answers.

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The Questions are:-

Q1:- Balance the given equation; $Ca + N_2 \rightarrow Ca_3N_2$

Q2:- In a balanced equation, Mass of reactants = _____.

Q3:- In the given equation tell the catalyst and temperature under which it will proceed.

$$N_2 + 3H_2 \xrightarrow{?} 2NH_3$$

I hope you all have written the answers by now. Let us check the answers now.

Ans1:- $3Ca + N_2 \rightarrow Ca_3N_2$

Ans2:- Mass of Products

Ans3:- $N_2 + 3H_2 \xrightarrow[450°C]{Fe+Mo} 2NH_3$
200-900 atm

Students, Now I am ending the lesson for today by giving "Instructions" and "Homework"

You all are required to read the lesson again and revise all the reactions which we have done in todays lesson

Do Q- 1, 4, 5 of Exercise 1(B) given on pg-no 15 of your chemistry notebook.

(Rudra)