SALTS

Definition: A salt is a compound consisting of a positive metallic ion (or) and negative ion derived from an acid

Types of salts;

I) Acidic salts

ii) Normal salts

iii) Basic salts

1. **Acidic salts**

This is the salt which contains part of the hydrogen ions of an acid

Example; Sodium hydrogen – sulphate

Calcium hydrogen carbonate

2. **Normal salts**

These are the salts which contain neither H^+ ions from the acid nor O^{2-} or OH^- ions from the base

Example; NaCl, $MgCl_2$,$MgSO_4$,$FeCl_2$,$CaCO_3$

3. **Basic salts**

These are salts containing or ions from the base

Example; MgOHCl, ZnOHCl

Magnesium hydroxyl chloride and zinc hydroxyl chloride

O is incorrect because oxygen exists in molecule state but not in atomic

In previous salts was classified according to the nature of salts but in terms of solubility there are two types of salts (i) Soluble salt (ii) Insoluble salt.

SOLUBILITY RULE states;

Soluble salts are;-

a) All salts of (made of) K, Na and NH^{+}_4

Example; KNO_3,KCl ,K_2SO_4 ,K_3PO_4 ,K_2CO_3,$NaHCO_3$

This is an acidic salt (because it gives out 2 positive ions of Na and H)

1. All nitrates

   Example; KNO_3

ii) All hydrogen carbonates

Example; $NaHCO_3$

b) All chlorides except

i) Silver chloride (AgCl)

ii) Mercury (I) Chloride (HgCl) iii) Lead (II) chloride ($PbCl_2$) which is soluble in hot water

N.B: In reactions the compound above are considered as solids (s)

c) All sulphates except

i) - Barium sulphate.

ii) - Lead (II) sulphate.

iii) - Calcium sulphate is slightly soluble in water.

Insoluble salt are;

a) All carbonates except those of K, Na, NH_4

b) All hydroxyl except those of K, Na, and Ca (which is slightly soluble in water)

Salt of strong acid and bases do not react with water

Solubility rule (summary)

i) All salts of K, Na and are soluble

ii) All nitrates are soluble

iii) All sulphates are soluble except those Ba, lead (II) and Ca

Vi) All chlorides are soluble except those Ag, lead (ii) and mercury (x)

All carbonates and hydroxides are insoluble except those of K, Na,

NB: - All acids are soluble unless when concentrated (aq)

- All oxides are labeled by solids (s)

Examples;

METHODS OF PREPARING SALTS

A: **SOLUBLE SALTS**

i) Direct combination of elements

Example; Burning Mg in chlorine gas

$Mg + Cl_2 \rightarrow MgCl_2$

Pass hot Al in Chlorine gas.

$2Al_{(hot)} + 3Cl \rightarrow 2AlCl_3$

ii) Addition of a metal to a dilute acid. But this method is restricted to metals above Hydrogen in the reactivity series.

A metal below hydrogen cannot displace hydrogen

Example;

$Zn + 2HCl_2 + H_{2(g)}$

$Na + H_2SO_4 \rightarrow Na_2SO_4 + H_{2(g)}$

iii) Addition of carbonates to a dilute acid.

Products = salt, water and carbon dioxide.

$CaCO_{3(s)}$ + 2HCl $\rightarrow CaCl_{2(aq)}$ + $H_2O_{(l)}$ + $CO_{2(g)}$

iv) Addition of an oxide to a dilute acid.

CaO + $H_2SO_4 \rightarrow CaSO_4$ + $H_2O_{(l)}$ + H_2O

v) The general method for preparing soluble salts is called crystallization, for example; Preparation of $ZnSO_4$

Procedure;

a) Add excess Zn to dilute in a beaker Add few crystals of and few drops of concentrated to speed up the reaction rate

1. If the reaction is still slow warm the mixture
2. When the reaction is over, filter and put the filtrate in an evaporating dish

c) Crystallization

The filtrate is evaporated and cooled. Check if the crystals are formed. If they are formed stop evaporating and leave it for clay.

The water attached or associated to the crystals is called **water of crystallization.**

$ZnSO_4.7H_2O$ is called zinc sulphatehepta hydrate.

B. **INSOLUBLE SALTS**

The insoluble salts are prepared by ionic precipitation also called double decomposition

Here two soluble salts are mixed and react by interchanging their radicals ion forming both soluble and insoluble salts.

$BaCl_{2(aq)}$ + $Na_2SO_{4(aq)} \rightarrow BaSO_{4(s)}$ +2NaCl

$Ba^{2+}{}_{(aq)}$ + $\cancel{2Cl}_{(aq)}$ + $\cancel{2Na}^{+}{}_{(aq)}$ + $SO_4{}^{2-}{}_{(aq)} \rightarrow BaSO_{4(s)}$ + $2\cancel{Na}^{+}{}_{(aq)}$ + $\cancel{2Cl}^{-}{}_{(aq)}$

$Ba^{2+}{}_{(aq)}$ + $SO_4{}^{2-}{}_{(aq)} \rightarrow BaSO_{4(s)}$

QUESTION;

Ions to get solid, what is the name of the reaction? It's a double decomposition reaction or ionic precipitation.

PROPERTIES OF SALTS

1. **COLOUR**

Some salts are coloured

For example; i) Iron (ii) salts are green

ii) Iron (ii) salts are yellow

iii) Iron (ii) salts are pale blue

iv) Nickel (ii) salts are green

v) Cobalt (ii) salts are pink

The colours of the above mentioned salts are due to the color of hydrated ion

Coloured salts are formed only in the group of transition elements. All elements in first 20 elements are not colored.

Other salts are not colored, for example; salts of Na, K, Ca, Pb, Zn, Al, Mg

2. **Hydrolysis**

This is the reaction of salts and water giving an acid or alkaline solution

Example:

$$NH_4Cl_{(aq)} + H_2O \rightarrow NH_4OH_{(aq)} + HCl_{(aq)}$$

$$Na_2CO_{3(aq)} + H_2O_{(L)} \rightarrow NaOH_{(aq)} + H_2CO_{3(aq)}$$

a) All salts of weak bases and strong acids hydrolyze to give acid solution

Example; NH_4, Cl, $FeCl_2$, $CuCl_2$,$Al_2(SO_4)$ etc.

b) All salts of strong bases and weak acids are hydrolyzed to give an alkaline solution

Example; Na_2CO_3 ,CH_3COONa, etc.

N.B: Salts of strong bases and strong acids are not undergoing hydrolysis. They only ionize when in solution:

Example; $NaCl + H_2O \rightarrow$There's no reaction.

3.**EXPOSURE TO AIR**

When salts are exposed to air they either lose water of crystallization or absorb water from the atmosphere

a) **Hygroscopic**

Is the action of absorbing water from the atmosphere without changing into solution NaCl, anhydrous copper II sulphate ($CuSO_4$) and $NaNO_3$ others are concentrated and copper II sulphate

b)**Deliquescent**

This is the action of absorbing water from the atmosphere by a solid to form a solution

Example; $MgCl_2$, $CaCl_2$, $FeCl_3$, $Ca(NO_3)_2$

Others are the hydroxides of K and Na

c) **Fluorescence**

This is the action of giving up water of crystallization of the solid to the atmosphere

Examples;

i) Hydrate sodium carbonate

$$Na_2CO_3.10H_2O \rightarrow Na_2CO_3.H_2O + 9H_2O$$

ii) Hydrated sodium sulphate

$Na_2SO_4.10H_2O \rightarrow Na_2SO_4 + 10H_2O$

iii) Hydrated magnesium sulphate

$MgSO_4.7H_2O \rightarrow MgSO_4.H_2O + 6H_2O$

4. HEAT EFFECTS ON SALTS

Different salts behave differently on heating. Most of the hydrated salts loose water of crystallization when heated. The anhydrous salts undergo chemical change when heated

I. Sulphates

a) Hydrated copper (ii) sulphate [$CuSO_4.5H_2O$]– changes colour from blue to white when heated

$$\underset{\text{Blue}}{CuSO_4.5H_2O} \xrightarrow{\Delta} \underset{\text{white}}{CuSO_4 + 5H_2O_{(g)}}$$

- If white copper (ii) sulphate ($CuSO_4$) is heated more strongly it becomes to black copper (ii) oxide (CuO

$$\underset{\text{White}}{CuSO_4} \xrightarrow{\Delta} \underset{\text{Black}}{CuO_{(S)} + SO_{3(g)}}$$

b) Hydrated iron (ii) sulphate loose all its water of crystallization on heating and changes from green to white

$$\underset{\text{Green}}{FeSO_4.7H_2O_{(s)}} \xrightarrow{\Delta} \underset{\text{white}}{FeSO_{4(s)} + 7H_2O_{(g)}}$$

c) When iron (ii) sulphate is heated strongly it decomposes to form black iron (iii) oxide, and SO_3 and $SO_{2(g)}$

$$\underset{\text{White}}{2FeSO_4} \rightarrow \underset{\text{black}}{Fe_2O_{3(s)}} + SO_{3(g)} + SO_{2(g)}$$

d) Iron (iii) sulphate when heated strongly it decomposes to form black iron (iii) oxide and SO_3 only.

$$Fe_2(SO_4)_{3(s)} \rightarrow Fe_2O_{3(s)} + 3SO_{3(g)}$$

White black

II) Chlorides

All chlorides of metals are hydrated except those of K, Na, Pb, Hg and Ag when heated, chlorides undergo a chemical change called hydrolysis (i.e. they don't form anhydrous chlorides) in which hydrogen chloride gas (and water involve and a basic salts of chloride or oxide are formed

Example;

$$MgCl_2.6H_2O_{(s)} \xrightarrow{\triangle} MgOHCl_{(s)} + HCl_{(g)} + 5H_2O_{(g)}$$

$$AlCl_3.6H_2O_{(s)} \xrightarrow{\triangle} AlO_{3(s)} + 8H_2O_{(g)} + 6HCl_{(g)}$$

$$ZnCl_2.6H_2O_{(s)} \xrightarrow{\triangle} ZnOHCl_{(s)} + HCl + 5H_2O_{(g)}$$

Ammonium chloride sublimes when heated

$$NH_4Cl_{(s)} \xrightarrow{\triangle} NH_{3(g)} + HCl_{(g)}$$

III) Carbonates and hydrogen carbonates

Carbonates of sodium and potassium are unaffected by heat (even at very high temperature)

Ammonium carbonate decomposes readily on heating to form $NH_{3(g)}$, $CO_{2(g)}$ and $H_2O_{(g)}$

$$(NH_4)_2CO3_{(s)} \xrightarrow{\triangle} 2NH_{3(g)} + CO_{2(g)} + H_20_{(g)}$$

All other carbonates decompose to give oxide and CO_2

$$Al_2(CO_3)_3 \xrightarrow{\Delta} Al_2O_3 + CO_2$$

$$K2CO3 \xrightarrow{\Delta} \text{NO Reaction}$$

All hydrogen carbonates decompose to give metal carbonates, water and CO_2 on heating

$$Mg(HCO_3)_2 \rightarrow MgCO_3 + H_2O + CO_2$$

$$2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$$

IV) Nitrates

Na and K nitrates decompose when heated to give corresponding nitrite and oxygen

$$NaNO_3 \rightarrow NaNO_2 + O_2$$

$$KNO_3 \rightarrow KNO_2 + O_2$$

- Ammonium nitrate decomposes on heating to give dinitrogen oxide and water

$$NH_4NO_3 \rightarrow N_2O + H_2O$$

- While the nitrite gives nitrogen and water

$$NH_4NO_2 \rightarrow N_2 + H_2O$$

- The metal nitrates (i.e. those of Ca, Mg, Al, Zn, Fe, Pb, Cu) decompose on heating to give the corresponding oxide, nitrogen dioxide and oxygen

$$Ca(NO3)_{2(s)} \rightarrow CaO_{(s)} + NO_{2(g)} + O_{2(g)}$$

$$Mg(NO_3)_{2(s)} \rightarrow MgO_{(s)} + NO_{2(g)} + O_{2(g)}$$

- Nitrates of heavy metals (Ag and Hg) decompose to give a metal, NO_2 and 0_2 on heating.

$AgNO_3 \rightarrow Ag + NO_2 + O_2$

$Hg(NO_3)_2 \rightarrow Hg + 2NO_2 + O_2$

V) Hydroxides

The hydroxide of Na and K are stable to heat ie. Don't decompose on heat even at very high temperature.

All other metal hydroxides decompose on heating to give the corresponding oxides and water vapor

$KOH \xrightarrow{\triangle} \text{No Reaction}$

$Mg(OH)_2 \xrightarrow{\triangle} MgO + H_2O$

5. SOLUBILITY AND SOLUBILITY CURVES

Solubility of a salt in a liquid is the maximum amount of the salt that will dissolve in $100cm^3$ of a liquid at any given temperature

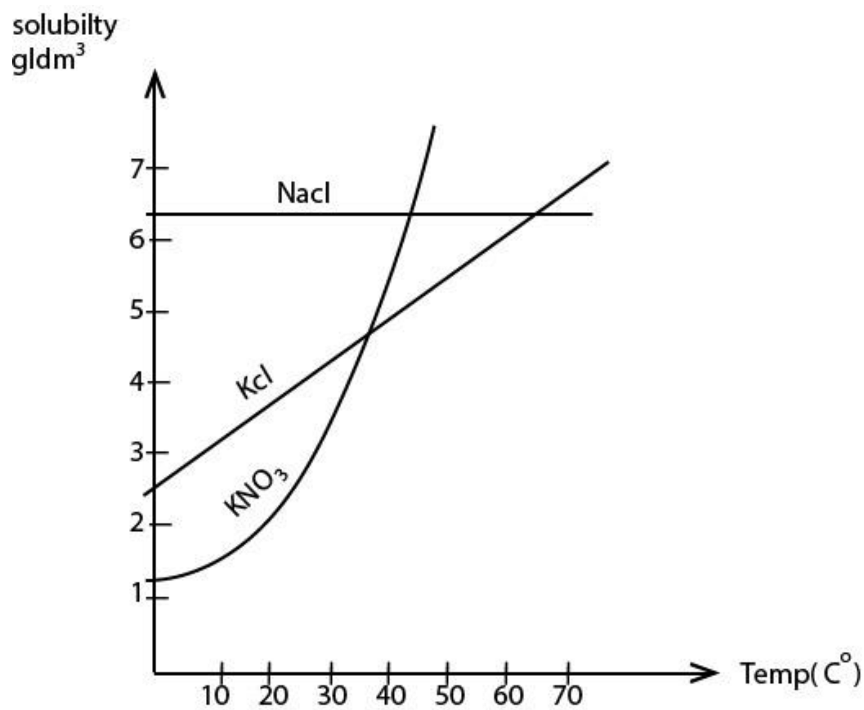
Solubility Curve

These are the graphs which show the variation of solubility with temperature

Solubility of a salt increases with the increase in temperature.

The steeper the solubility curve the more soluble the salt and the easier it is to crystallize that salt

SOLUBILITY AND SOLUBILITY CURVES.



The diagram above is a graph of solubility against temperature. The vertical component is a solubility of substance in gram per dm^3 , where by horizontal component is temperature of a substance. The graph drawn in the plane is analysis of two related variables (solubility and temperature). The change of solubility related to change of temperature.

From the accumulated data due to the test of salts NaCl, KCl and KNO_3 analyzed in the graph as drawn above.

(i) A graph of NaCl interpret that, it has a constant solubility at any temperature. The increase or decrease of temperature does not affect its solubility.

(ii) A graph of KCl is a smooth linear graph which interpret that for every change of temperature give the effect change of solubility. Therefore KCl is more soluble than NaCl.

(iii) A graph of KNO_3 is a curved graph interpret that the change of temperature gives a rapid solubility. Therefore a salt KNO_3 is more soluble than NaCl and KCl.

Assignment;

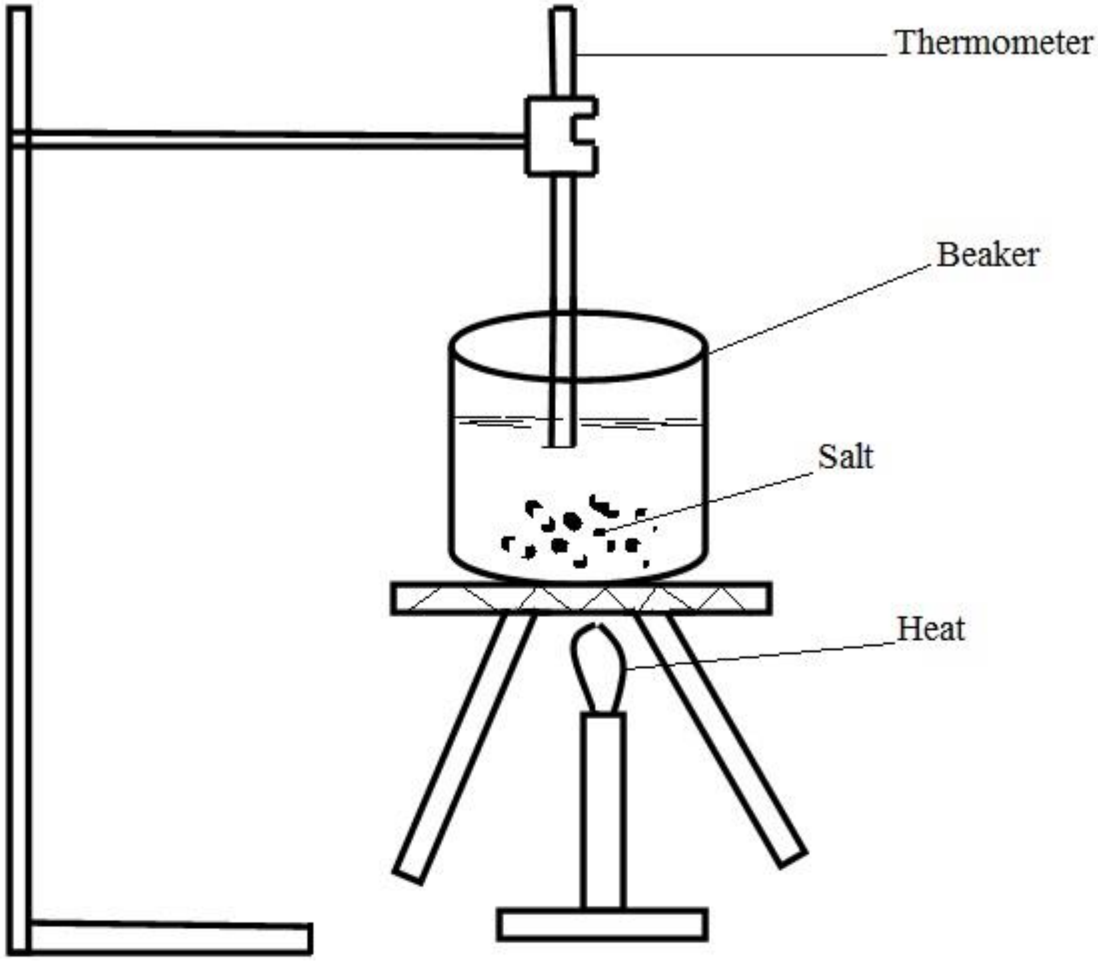
Take a salt of $NaNO_{3(S)}$ to examine its solubility.

Procedure

(i) Measure 1litre of distilled water and pour it into the beaker.

(ii) Measure 1g of $NaNO_3$ by electronic balance and pour into the beaker.

(iii) By heat source, tripod stand, wire gauze, retort stand and thermometer make connection and heat both water and sample salt.



(iv) Watch a disappearance of salt particles until all finish and record the temperature as follows;

Salt (g)	1	2	3	4	5	6	7	8
Temperature (°C)								

(v) Repeat procedure (ii) for except 2,3,4,5,6,7 and 8

(vi) Draw a graph of solubility against temperature.

USES OF SALT IN DAILY LIFE

Salt is essential for life, because it has more than 14000 users in daily. But the common uses categorized into Food, Agriculture,Water conditioning, High way Deicing and Industrial chemicals.

1. FOOD

i) A salt of sodium chloride is mixed with food as flavoring, (common salt).

ii) A salt of sodium chloride (NaCl)is mixed in the food industrial product as both flavoring and preservative.

iii) A salt of sodium bicarbonate ($NaHCO_3$) 'bicarb' is used in cooking as raising agent for cakes, bread e.t.c.

Baking powder

Is a mixture of sodium hydrogen carbonate and tartaric acid, The mixture helps to keep the PH neutral.

2. AGRICULTURE

A salt is very important in agriculture since used as land additive nutrients. A fertilizers of Ammonium sulphate ($NH_4SO_{4(S)}$) and Sodium nitrate ($NaNO_3$) salt are used to make land fertility to help healthier growing of crops.

3. WATER CONDITIONING

i) In the purification of urban water (Permutit process),the salt of Aluminum silicate is used to remove permanent hardness of water ($Al(SiO_3)_3$).

ii) Sodium carbonate ($Na_2CO_{3(S)}$) called washing soda, is used to make water soft by replacing calcium ions by sodium ions.

iii) Sodium chloride is used in a water softener to generate the ion exchange column.

4. HIGH WAY DEICING

A salt of sodium chloride (NaCl) is mixed with grit and spread on roads to prevent road freezing in cold condition.

5. INDUSTRIAL USES

i) The salt of potassium Iodide (KI) is added to sodium chloride (common salt) to prevent a lack of Iodine in the diet.

ii) The salt of sodium carbonate is used in the manufacture of glass.

MOLE CONCEPT

What is mole?

Mole is a unit of measurements as any other units,

Example Pair, dozen, gross etc

1mole = 6.02×10^{23} particles

Definition;

A **mole** is the amount of a substance as many as particles of elementary entities contained in 12g of carbon-12 isotopes. The particles can be atoms, molecules, electrons or ions. This is a unit mole which was introduced by **Avogadro**as **6.02×10^{23} particles**

Example; 1 mole of water (H_2O) contains 6.02×10^{23} molecules

1 mole of sodium (Na) contains 6.02×10^{23} atoms

1 mole of $CuCl_2$ contains 6.02×10^{23} ions

1 mole of Fe contains 6.02×10^{23} electrons

<u>MOLAR MASS OF A SUBSTANCE</u>

Molar mass: is the mass of I mole of any element or compound

Its SI unit is g/mol. It is denoted by M

For example; Na = its molar mass = 23g/mol

NaCl = its molar mass = 58.5g /mole

Na_2SO_4 = its molar mass = (23 x 2) + (32) + (16 x 4) = 142g/mol

NB: Molar masses and relative molecular mass of a substance are calculated from the formula of that substance.

QUESTION;

Calculate the molar of the following

1. $Na_2CO_3 . 10 H_2O$

11. $Al_2 (SO_4)_3$

Al = 27, S = 32, O = 16, Na = 23, C = 12, H = 1

2. Calculate the number of molecules in i. 8g of oxygen gas

ii. 11g of CO_2

3. If the number of ions in $CuCl_2$ is 3.02×10^{23}, what was the mass of $CuCl_2$

ANSWERS:

1. $Na_2CO_3.10H_2O$

(23 x 2) + 12 + (16 x 3) + 10 [(1 x 2) + 16]

46 + 12 + 48 + 180

106 + 180 = 286g/mol

ii) $Al_2 (SO_4)_3$

(27 x 2) + 3 (32 + (16 x 4))

54 + 3(96)

54 + 288 = 342g/mol

Iii). 8g of oxygen gas

$O_2 = 16 \times 2 = 32 = 6.02 \times 10^{23}$

8 =?

$$\frac{6.02 \times 10^{23} \times 8}{32}$$

$= 1.505 \times 10^{23}$ molecules

IV). 11g of CO2

$CO_2 = 12 + 32 = 44 = 6.02 \times 10^{23}$

11 =?

$$\frac{6.02 \times 10^{23} \times 11}{44}$$

$= 1.505 \times 10^{23}$ molecules

$CuCl_2$

$64 + (35.5 \times 2) = 64 + 71 = 135 = 6.02 \times 10^{23}$

? $= 10^{23}$

$$\frac{3.02 \times 10^{23} \times 135}{6.02 \times 10^{23}}$$

= 67.5 g/mol

RELATIVE MOLAR MASS (M_r)

This is the mass of one molecule of a compound compared with the mass of one atom of carbon – 12.

It has no units

Molar mass (M) = Relative molecular mass (M_r)

Molar mass of an element = relative atomic mass (A_r)

Example; Na M of Na = $23gmol^{-1}$

A_r of Na = 23

M or CH_4 = $16gmol^{-1}$

Mr of CH_4 = 16

M of H_2O = 18gmole

Mr of H_2O = 18

Example;

1. Calculating the molar mass of $(NH_4)_2CO_3$ given that N = 14, H= 1, C = 12, O = 16.

Solution

$(NH_4)_2CO_3$

(14g x 2) + (1g x 8) + 12g + (16g x 3)

28g/mol + 8g/mol + 12g/mole + 48g/mol

= 96g/mole

<u>Molar mass of a compound</u>

This is the sum of constituent atoms (elements)

<u>AMOUNT OF A SUBSTANCE OR NUMBER OF MOLES (n)</u>

Number of moles, n is the mass of the sample of a substance divided by the molar mass of that substance

$N = \frac{m}{M}$ whereby m = mass of a sample

M = Molar mass of substance

N = number of moles (amount of substance)

Example;

What is the amount of substance in

a) 180g of carbon

m = 180g

M = 12gmol^{-1}

$$N = \frac{180\ g}{12\ g/mol}$$

n = 15mol

b) 180g of CO_2

$$N = \frac{m}{M}$$

$$N = \frac{180\ g}{44\ g/mol}$$

n = 4.09 mol

QUESTIONS:

Finding the mass of each of the following substance

a) 2.4 mol of NaOH

b) 3.2×10^{-3}mol of N

c) 0.780 mol of $Ca(CN)_2$

d) 7.00 mol of H_2O_2

How many moles are in each of the following?

a) 0.800g of Ca

b) 79.3g of Cl_2

c) 5.96g of KOH

d) 937g of $Ca(C_2H_3O_2)_2$

NUMBER OF PARTICLES (N) IN A GIVEN AMOUNT OF SUBSTANCE (n)

To find the number of particles in a given amount of substance we use the expression

N = n.L

Where: n = number of moles

N = number of particles in a substance

L = Avogadro's no = 6.02 x 1023 mol^{-1}

QUESTION:

1. How many particles are there in 20g of Ca?

Solution

Find n in 20g of Ca

$$N = \frac{20\text{ g}}{40\text{ g/mol}}$$

N = 0.5 mol

From the expression

N = nL

= 0.5 mol x 6.02 x 10^{23} mol^{-1}

= 3.01 x 10^{23}

2. How many molecules are there in 80g of the NaOH?

MOLAR VOLUME (V_m)

MOLAR GAS VOLUME

This is the volume occupied by one mole of a gas at standard temperature and pressure and is 22.4 dm^3 or 22.4l

$1dm^3 = 1l = 1000cm^3$

Standard temp = 0^0c (273K)

Standard pressure = 1 atm (760 mm Hg)

Avogadro's law states "At the same temperature and pressure volumes of all gases contain the same number of particles"

In calculating the amount of substance n, using molar volume (v_m), the expression used is

$$\text{Amount of substance n} = \frac{\text{volume of gas}(\text{dm}^3\ )}{\text{Molar volume}(\frac{\text{dm}^3}{\text{mol}})}$$

$$\text{Amount of substance} = \frac{v}{22.4\,\frac{\text{dm}^3}{\text{mol}}}$$

Example; Find the amount of substance present in

a) 18.8 dm^3 of CO_2 at s.t.p

b) 48.8 dm^3 of O_2 at s.t.p

Solution

$$\text{From the expression n} = \frac{v}{v_m}$$

Where; V = volume of a gas

V_m = molar volume of a gas

n = amount of substance

V = 18. 8 dm3

V_m = 22.4 dm3/ mol

n =?

Substituting the volume in the expression

$$\frac{18.8}{22.4}$$

n = 0.839 mol

b) $N = \frac{48.8dm^3}{22.4dm^3/mol}$

n = 2.18 mol

THE MOLE IN STOICHIOMETRIC CALCULATIONS

A balance chemical equation tells us a great of quantitative information

Consider the following equation us a great deal of quantitative information

Consider the following balanced equation

$$2H_6 + O_2 \rightarrow 2H_2O$$

$$4g + (16x2 = 332g) \rightarrow 36g$$

2moles 1mol 2mol

Stoichiometry- is the quantitative relationship of reacting substances

Stoichiometric coefficients = moles

A balanced equation is used in calculating different quantities

Example; $CaCO_3 \rightarrow CaO + CO_2$

From the above balanced equation, calculate the weight of CaO and Volume of CO_2 at s.t.p which will be produced by heating 75g of $CaCO_3$

(Ca = 40, C = 12, O = 16)

Solution

Finding the molecule mass

$$CaCO_3 \rightarrow CaO + CO_2$$

$(40 + 12 + 48)$ $(40 + 16)$

Molecular mass of $CaCO_3$ = 100g

CaO = 56g

From the equation:

$CaCO_3 \rightarrow CaO + CO_2$

1 mol 1mol 1mol

100g 56g

15g x?

$100\text{g produces } 56\text{ g} = \frac{100\text{ gx}}{100\text{g}} = \frac{56\text{g x } 75\text{g}}{100\text{ g}}$

75g produces ?

x=42g

If 100g/mol = 22.4dm^3

75g/mol =?

= 16.8 dm^3

QUESTION

a) How many ions are in 10g of $Al_2(SO_4)_3$?

b) How many fluorides are in 1.46mols of AIF_3?

Solution;

1(a) $Al_2(SO_4)_3 \rightarrow 2Al^{3+} + 3SO_4^{2-}$

342g/mol 2mol 3mol

342 g/mol = 5 mol of ions

10 g = ?

If 342 g = 1 mol

10 g = x

x = 0.0292 mol of $Al_2\ (SO_4)_3$

If 1 mol of $Al_2(SO_4)_3$ = 5mol of ions

0.0292mol of $Al_2(SO_4)_3$ = ?

$$\frac{0.0292 \text{ mol x } 5 \text{ mol of ions}}{1 \text{ mol}}$$

= 0.0146 mol of ions

N = nL

= 0.046 mol x 6.02 x 1023 mol-1

= 8.79×10^{23}

SOLUTION AND MOLAR CONCENTRATION

Solution is a mixture of solvent and solute.

Solute - Is a solid crystal component which dissolved into solvent.

Solvent - Is a liquid component which dissolve solute. (water is a common universal solvent).

So that when we prepare a standard solution, we must measure both two component. A solute measured in grams of weight and solvent in liter, dm3 or cm3 of its volume. The quantity of solute that may dissolved by 1litre of solvent make a standard solution.

STANDARD SOLUTION

Is a solution of known concentration. Standard solution has been prepared by accurate measurement and the concentration of solute in the solution is described into two ways.

i. Weight concentration in grams.

ii. Particles concentration in mole.

i. WEIGHT CONCENTRATION

This concentration abbreviated as conc. of a grams dissolved in one litre (g/dm3 or g/L).

e.g 30g/L or 15g/dm3

Example;

Allen dissolved two spoons of sugar into the tea drink. If capacity of cup is 200cm3 and a spoon carry 25g, what is the concentration of sugar in the tea?

Solution

carrying capacity = 25g

25 x 2 = 50g

Therefore, weight of solute = 50g

Volume of solvent = 200cm3

But,

$$50g \longrightarrow 200cm^3$$

$$X? \longrightarrow 1000cm^3$$

$$X = \frac{50g \times 1000cm^3}{200cm^3} = 250g$$

Therefore, conc. = 250g/L

MOLARITY (MOLAR CONCENTRATION)

This is a concentration of particles contained in one litre of the solution. (mol/L or M)

Example;

The Allen spin a common salt in the bowl filled by 320cm3 of water to make a solution. If the same spoon used, determine a molarity of salt in the solution.

Solution

Volume of water = 320cm3

Weigh of salt = 25g

But, Moles = weight of component/Molar mass (W/Mr)

n = 25g/58.5g

n = 0.43moles

Therefore,

$$0.43moles \longrightarrow 320cm^3$$

$$X? \longleftarrow 1000cm^3$$

$$X = \frac{0.43moles \times 1000cm^3}{320cm^3} = 1.3$$

Therefore, Molarity = 1.3mol/L

RELATIONSHIP OF WEIGHT AND MOLAR CONCENTRATION

From,

Molarity = moles/Volume in litre

M = n/V in L

But,

n = W/Mr

Therefore,

M = W/Mr X 1/V in L

But,

W/V in L = Conc

Therefore,

M = Conc/Mr

So that,

Molarity = Conc/ Molar mas

Where by,

n = no of moles

V = Volume in liter

Mr = Molar mass

W = Weight of component in grams

Assignment

Find the molarity of each component if both had a concentration of 72g/dm3 .

(a) H_2SO_4
(b) Na_2CO_3
(c) $NaHCO_3$
(d) KCl