

LESSON NOTES

Year/Level: 11 C/D

week 18

Subject: Chemistry

Strand	3 Reactions
Sub Strand	3.3 acids, bases and salts
Content Learning Outcome	- Write the formula, chemical names, common names and uses of some salts - State some properties of the salts - State the solubility rules of salts and use it to predict the formation of a precipitate - Calculate the percentage of water of crystallization in a hydrated salt

Salts

A salt is an ionic compound that is formed when acids react with base.

Common Salts, their Common Names and Important Use

Chemical Name	Formula	Common name	Uses
Ammonium chloride	NH_4Cl	Salt ammoniac	Electrolyte in dry cell
Copper sulphate	CuSO_4	Blue stone	Drying agent, fungicide
Calcium carbonate	CaCO_3	Marble/chalk	Blackboard chalk, dietary supplement
Calcium sulphate	CaSO_4	Plaster of Paris	Making Plaster of Paris, food additive
Calcium oxychloride	CaOCl_2	Bleaching powder	Commercial bleach, water treatment
Magnesium sulphate	MgSO_4	Bitter salt	Laxative, as fertilizer
Sodium chloride	NaCl	Salt	Flavor enhancer, preservative
Sodium hydroxide	NaOH	Caustic soda	Making paper, manufacturing textile
Sodium sulphate	Na_2SO_4	Glaubers salt	Dyeing textile
Sodium bicarbonate	NaHCO_3	Baking soda	Antacid, soothe insect bite

PROPERTIES SALTS

- Product of an acid-base reaction
- Many are soluble
 - for this reason most drugs are a salt, most specifically sodium-this gets the drug into the bloodstream as all sodium compounds are soluble
 - if a drug cannot be turned into a salt it will not dissolve in water and is useless to a patient as it will not enter the bloodstream
- Ionic compounds
- Hygroscopic: they absorb water very well to form hydrate

SOLUTIONS OF SALTS

- When salts dissolve in water, the ions dissociate (it will separate into positive and negative ions)
e.g. $\text{NaCl}_{(s)} \longrightarrow \text{Na}^+_{(aq)} + \text{Cl}^-_{(aq)}$

- Molecular compounds do not form ions when they are dissolved in water (because they do not carry charges)
e.g. $\text{C}_6\text{H}_{12}\text{O}_6(\text{s}) \longrightarrow \text{C}_6\text{H}_{12}\text{O}_6(\text{s})$
- Solutions of ionic compounds conduct electricity. **Why?** When ionic compounds dissolve in water the positive and the negative ions dissociate and these ions are able to conduct electricity.

DECOMPOSITION OF SALT

- Salts decompose (breakdown) to form **metal oxides**
- **Carbonates** decompose to form **metal oxide** and **carbondioxide** when they are heated.
- That is, carbonate $\xrightarrow{\text{HEAT}}$ metal oxide + carbondioxide
 $\text{CaCO}_3 \xrightarrow{\text{HEAT}} \text{CaO} + \text{CO}_2$
- **Nitrates** decompose into metal oxide, nitrogen oxide and oxygen
e.g. $\text{Cu}(\text{NO}_3)_2 \xrightarrow{\text{HEAT}} \text{CuO} + 2\text{NO}_2 + \text{O}_2$

SOLUBLE AND INSOLUBLE SALTS

- A **salt** that **dissolves** in water are called **soluble** and those that **does not dissolve** in water are called **insoluble salts** (forms precipitate)

RULES OF SOLUBILITY

Salt	Rule	Exceptions
Nitrates	All are soluble	None
chlorides	All are soluble	Chlorides of silver, Ag^+ and lead, Pb^{2+} .
Sulphates	All are soluble	Sulphates of barium, Ba^{2+} , calcium, Ca^{2+} , and lead, Pb^{2+}
Carbonates	None are soluble	Carbonates of K^+ , Na^+ and NH_4^+
Hydroxides	None are soluble	Hydroxides of K^+ , Na^+ and NH_4^+

Precipitation Reaction

- Occurs when the mixing of two solutions leads to the formation of an insoluble solid
e.g. $\text{NaCl} + \text{AgNO}_3 \longrightarrow \text{NaNO}_3 + \text{AgCl}$

$$\begin{array}{c} \text{Na}^+ : \text{Cl}^- \text{ Ag} \\ \quad \quad \quad \swarrow \\ \quad \quad \quad + : \text{NO}_3^- \\ \hline \text{NaNO}_3 : \text{AgCl} \\ \text{(Spectator)} \quad \text{(ppt)} \end{array}$$

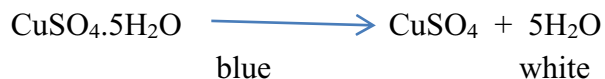
Spectator ions

- are ions that do not take part in the reaction e.g. Na^+ and NO_3^-

ANHYDROUS AND HYDRATED SALTS

- **Hydrates** are generally crystalline salts which contain a specific ratio or definite proportion of water in a compound. This water is called the **water of crystallization**.
- Hydrates are formed by slowly evaporating the water from the salt solutions
- An example of a hydrate is copper sulphate pentahydrate crystals, $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
- **Anhydrous** compounds are formed when hydrates are strongly heated and the water of hydration is driven off.

- When the blue crystalline copper sulphate pentahydrate is heated it changes to a white, powdery, anhydrous salt.



CALCULATING THE WATER OF CRYSTALLIZATION (W.O.C)

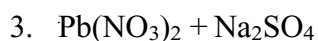
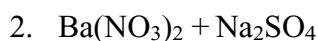
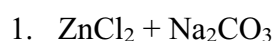
$$\text{W.O.C} = \frac{\text{Molecular mass of water}}{\text{Formular mass of salt}} \times \frac{100}{1}$$

Example: Calculate the percentage w.o.c in $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$.

$$\begin{aligned} \text{Solution: } \text{W.O.C} &= \frac{\text{Molecular mass of water}}{\text{Formular mass of salt}} \times \frac{100}{1} \\ &= \frac{90}{250} \times \frac{100}{1} \\ &= 36\% \end{aligned}$$

Activity

1. Tell whether a precipitate will form or not. Write the balanced equation for the reactions and state the ppt and spectator ions



2. The reaction that occurs when a number of solutions are mixed is shown in the table given below.

Reacting Solution	Sodium chloride	Sodium sulphate	Sodium carbonate
Silver nitrate	I	A white ppt of silver sulphate forms	A white ppt of silver carbonate forms
Barium chloride	No reactions	II	A white ppt of barium carbonate forms
Copper chloride	No reaction	No reaction	III

Write down the observation at I, II, III

3. Calculate the percentage water of crystallization of the following hydrates

(a) Sodium carbonate crystals (washing soda) - $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$

(b) Barium iodide crystals - $\text{BaI}_2 \cdot 7\text{H}_2\text{O}$

(c) Magnesium sulphate crystals - $\text{MgSO}_4 \cdot 5\text{H}_2\text{O}$

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b. _____

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c. _____

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4. Marica did an experiment to find out the percentage of water of crystallization in copper sulphate crystals. The data is given below.

Mass of empty crucible- 42.5g

Mass of crucible+ hydrated CuSO_4 crystals- 49.7g

Calculate the percentage of water of crystallization in the sample.

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