CHAPTER NO 09

ACIDS, BASES AND SALTS

Q1. Define the following terms:

1. Acid	**2. Base**	**3. Strong Acid**	**4 .Strong base**
5.weak Acid	**6.Weak base**	**7. Neutralization**	**8. Titration**
9. Standard solution	**10. Acidity of base**	**11.Basicity of acid**	

1. ACID:

"The compound which produce hydrogen ions (H^+) in an aqueous solution is called acid."

Examples:

HCl, H_2SO_4 etc.

2. BASE:

"The compound which produce hydroxide ions (OH^-) in an aqueous solution is called base."

Example:

NaOH, KOH etc

3. STRONG ACID:

"Acid which ionizes completely in an aqueous solution is called strong acid."

Example:

HCl, H_2SO_4 and HNO_3

4. STRONG BASE:

"Base which ionizes completely in an aqueous solution is called strong base."

Example:

NaOH, KOH, $Ca(OH)_2$

5. WEAK ACID:

"Acid which do not ionizes completely in an aqueous solution is called weak acid."

Example:

Acetic acid CH_3COOH , Oxalic acid $(COOH)_2.2H_2O$

6. WEAK BASE:

"Base which donot ionizes completely in an aqueous completely is called weak base."

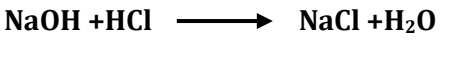
Example:

NH_4OH , $Mg(OH)_2$

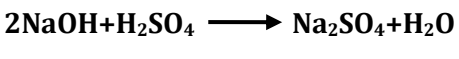
7. NEUTRALIZATION:

"Such a reaction in which acid and base reacts together to from salt and water is called neutralization."

Example:



$NaOH + HCl \longrightarrow NaCl + H_2O$



$2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O$

8. TITRATION:

"It is a chemical technique used to determine the concentration of unknown solution with the help of standard solution."

9. STANDARD SOLUTION:

"A solution whose concentration is already known is called standard solution."

10. ACIDITY OF BASE:

"The number of ionizable or replaceable (OH^-) ions present in a molecule of base is called acidity of the base."

11. BASICITY OF ACID:

"The number of ionizable or replaceable (H^+)ions present in a molecule of acid is called basicity of acid."

Q2. Describe the various concepts of acid and base with examples.

Several theories have been proposed to answer the question that what is an acid and what is a base.

1. ARRHENIUS CONCEPT:

INTRODUCTION:

In 1887 a Swedish scientist Arrhenius presented the concept about acid and base.

STATEMENT:

"An acid is a substance which produces H^+ ions in an aqueous solution and a base is a substance which produces OH^- ions in an aqueous solution."

Example:

Acid:

$$HCl \longrightarrow H^+ + Cl^-$$

$$HNO_3 \longrightarrow H^+ + NO^-_3$$

Base:

$$NaOH \longrightarrow Na^+ + OH^-$$

$$KOH \longrightarrow K^+ + OH^-$$

2. BRONSTED AND LOWRY CONCEPT:

INTRODUCTION:

In 1923,Danish chemist Bronsted and an English chemist Lowry presented more satisfactory definition of acid and base.

STATEMENT:

"An acid is a substance having a tendency to donate one or more protons and a base is substance having a tendency to accept protons."

Example:

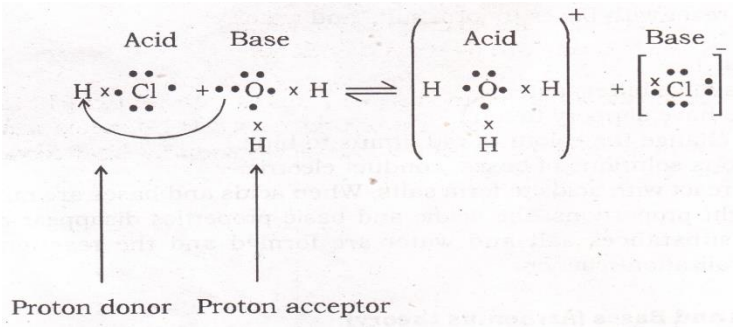
HCL and water are proton donor and act as Bronsted Lowry acid whereas water and ammonia are proton acceptors and act as Bronslet Lowry bases.

Example:

1. Reaction:

$$HCl + H_2O \longrightarrow H_3O^+ + Cl$$

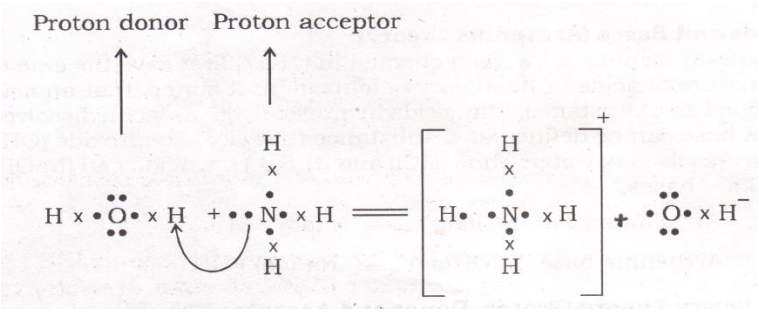
Mechanism:



2. Reaction:

$$H_2O + NH_3 \longrightarrow HN_4^+ + OH^-$$

Mechanism:



3. LEWIS CONCEPT:

INTRODUCTION:

In 1923, an American chemist Lewis Preselet more general concept of acid and base.

STATEMENT:

"An acid is any species (ion or molecule) which can accept a pair of electron and a base is any species (ion or molecule) which can donate a pair of electron."

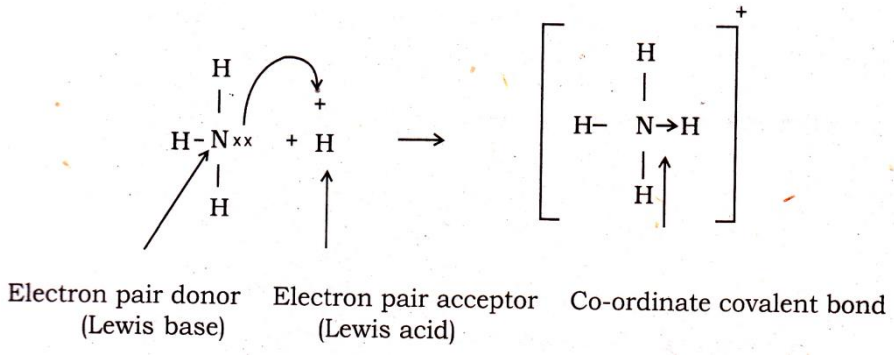
Explanation with example:

When ammonia (NH_3)reacts with hydrogen ion (H+) to from ammonum ion (NH_4^+) in which the nitrogen of NH_3donate a pair of electron whereas H^+ion accept the pair of electron for bond formation. This is shown by curved arrow.

Reaction:

$$NH_3 + H^+ \longrightarrow NH_4^+$$

Mechanism:



Q3. Write down the physical properties of acid and base.

PHYSICAL PROPERTIES OF ACID:

1. Acids have sour taste.

2. They change the color of blue litmus paper into red .

3. Colorless phenolphthalein remain colorless in acid.

4. Acids are electrolyte (Their aqueous solution can conduct electricity)

5. Concentrated acid can damage skin fabrics and human tissues.

PHYSICAL PROPERTIES OF BASE:

1. They have bitter taste and have slippery and soapy touch.

2. They turned colorless phenolphthalein into red or pink.

3. They change the color of red litmus paper into blue.

4. Bases are electrolyte (their aqueous solution am conduct electricity.

5. Concentrated bases can damage skin fabrics and human tissues.

Q4. Write down the chemical properties of acid.

CHEMICAL PROPERTIES OF ACID:

1. Reaction with base:

Acid reacts with base to from salt and water this reaction is called neutralization.

$$HCl + NaOH \longrightarrow NaCl + H_2O$$

2. Reaction with carbonates and bicarbonates:

Acid reacts with carbonates and bicarbonates to form salt, carbon oxide and water

$$2HCl + CaCO_3 \longrightarrow CaCl_2 + H_2O + CO_2$$
(carbonate) (Salt) (Water) (carbondioxide)

$$H_2SO_4 + NaHCO_3 \longrightarrow NaHSO_4 + H_2O + CO_2$$
(bicarbonate) (salt) (water) (carbon dioxide)

3. Reaction with metals:

Acid reacts with some metal to give salt and hydrogen gas.

$$Zn + 2HCl \longrightarrow ZnCl_2 + H_2$$
(metal) (acid) (salt) (hydrogen gas)

Q5. What is salt. Describe the kinds of salt with examples.

SALT:

"An ionic compound produced by neutralization between acid and base having positive and negative ions is called salt."

Example:

1. $NaOH + HCl \longrightarrow NaCl + H_2O$
(salt)

2. $KOH + HNO_3 \longrightarrow KNO_3 + H_2O$
(salt)

TYPES OF SALT:

Salt can be divided into three groups.

1. Normal Salts. **2. Acidic Salts.** **3. Basic Salts.**

1. NORMAL SALT:

"A salt which is formed by complete ne acid by a base is called normal salt."

Examples:

NaCl, $NaNO_3$, K_2SO_4, $MgSO_4$ etc are normal salts.

2. ACIDIC SALT:

"A salt which is formed by the partial or incomplete neutralization of an acid by a base is called acidic salt."

Example:

$KHSO_4$, $NaHSO_4$, $NaHCO_3$, are acidic salts.

3. BASIC SALT:

"A salt which is formed by the partial or incomplete neutralization of a base by an acid is called basic salt."

Example:

Mg(OH) Cl ,Zn (OH) Cl are basic salts

Q6. What is double salt? Write its examples with formulae.

DOUBLE SALT:

"A crystalline compound which is obtained when two specific salts are crystallized together is known as double salt."

Examples:

Name	Formula
1. Potash Alum	$K_2SO_4 . Al_2(SO_4)_3 . 24H_2O$
2. Chrome Alum	$K_2SO_4 . Cr_2(SO)_3 . 24H_2O$
3. Carnalite	$KCl . MgCl . 6H_2O$
4. Mohr's Salt	$FeSO_4 . (NH_4)_2 SO_4 . 6H_2O$

Q7. Write down the industrial preparation of sodium carbonate (Na_2CO_3) by ammonia Solvay process.

INDUSTRIAL PREPARATION OF Na_2CO_3 BY AMMONIA SOLVEY PROCESS:

The industrial process involves the following step:

Step no1:

First of all limestone ($CaCO_3$) is strongly heated in a special furnace under high temperature

$$CaCO_3 \xrightarrow{heat} CaO + CO_2$$

Step no2:

The quick lime (CaO) combines with ammonium chloride (NH_4Cl) to form ammonia gas (NH_3) in another chamber

$$2NH_4Cl + CaO \longrightarrow 2NH_3 + CaCl_2 + H_2O$$

Step no 3:

In the Solvay mixing chamber ammonia(NH_3), carbondioxide (CO_2)and water (H_2O) are mixed then ammonium bicarbonate (NH_4HCO_3) is formed

$$NH_3 + CO_2 + H_2O \longrightarrow NH_4HCO_3$$

Step no 4:

Ammonium bi carbonate (NH_4HCO) is combined with cold solution of NaCl then sodium bicarbonate $(NaHCO)_3$ and ammonium chloride (NH_4Cl) are formed .

$$NaHCO_3 + NaCl \longrightarrow NH_4Cl + NaHCO_3$$

Step no 5:

Sodium carbonate can be prepared by heating sodium bicarbonate.

$$2NaHCO_3 \xrightarrow{heat} Na_2CO_3 + H_2O + CO_2$$

Step no 6:

Finally anhydrous sodium carbonate (Soda ash) is crystallized into washing soda ($Na_2CO_3.10H_2O$).

Q8. Write down the uses of sodium carbonate (Na_2CO_3) and sodium bi carbonate ($NaHCO_3$).

USES OF Na_2CO_3:

1. **It is used as cleaning agent in soap and detergent.**
2. **It is used to make ordinary glass which is used to make bottles.**
3. **Hard water is changed into soft water by adding Na_2CO_3**

USES OF $NaHCO_3$ (Baking soda):

1. **It is used as baking powder**
2. **It is used in the preparation of effervescent drinks and fruit salts.**
3. **It is used in medicines to remove acidity in stomach.**
4. **It is used in fire extinguishers.**

Q9. Write down the preparation and uses of the following compounds.

1. Copper Sulphate 2. Magnesium Sulphate 3. Potash Alum.

1. COPPER SULPHATE ($CuSO_4.5H_2O$)

Preparation:

Copper sulphate or cupric sulphate which is also known as blue vitrol or blue stone has two preparation methods:

Method I:

It is prepared by the reaction of copper scraps with dilute sulphuric acid in the presence of air.

$$2Cu + 2H_2OS_4 + O_2 \longrightarrow 2CuSO_4 + 2H_2O$$

Method II:

It is also prepared by reaction of CuO or $CuCO_3$ with dilute sulphuric acid.

$$CuO + H_2SO_4 \longrightarrow CuSO_4 + H_2O$$

$$CuCO_3 + H_2SO_4 \longrightarrow CuSO_4 + CO_2 + H_2O$$

USES OF COPPER SULPAHTE:

1. **It is used in electric batteries, hair dyes and in electroplating.**
2. **As germicides, insecticides, preservation for food and paper pulp.**
3. **In printing, making synthetic rubber and copper salts.**
4. **In paints and varnish industry.**

2. MAGNESIUM SULPAHTE: ($MgSO_4.7H_2O$) (Epsom salt)

Preparation:

It is prepared by the action of H_2SO_4 and $MgCO_3$ (magnisite) or $MgCO_3$. $CaCO_3$ (dolomite)

1. $MgCO_3 + H_2SO_4 \longrightarrow MgSO_4 + H_2O + CO_2$
2. $MgCO_3 \bullet CaCO_3 + H_2SO_4 \longrightarrow MgSO_4 + CaSO_4 + 2H_2O + 2CO_2$

USES OF MAGNESIUM SULPHATE:

1. It is used in dyeing and tanning process.
2. It is used in making fire proof fabrics.
3. It is used as a filler in paper industry.
4. It is also used in medicines and in match boxes.

3. POTASH ALUM: ($K_2SO_4 . Al_2 (SO_4)_3 . 24H_2O$)

Preparation:

It is a double salt can be prepared by adding equal molar solution of potassium sulphate (K_2SO_4) and aluminum sulphate [$Al_2(SO_4)_3$] by dissolving in water. The solution is crystallized to form potash alum.

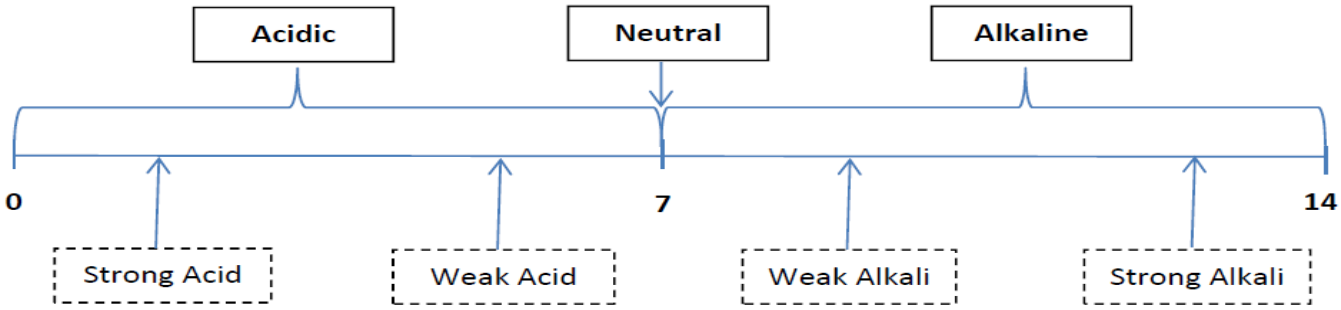
USES OF POTASH ALUM:

1. It is used in dyeing as mordant to fix the dye to the fabric.
2. It is used as an anti-septic and as mouth wash.
3. It is used in purifying water.
4. It is also used in medicines.

Q10. What is pH scale?

pH SCALE:

The pH scale measures how acidic and basic a solution is the pH scale usually ranges from O-14. Aqueous solution at 25°C with a pH less than 7 are acidic while those with a pH greater than 7 are basic if a pH of any solution is 7 then it is defined as neutral.



Q11. Identify the following acids as, mono basic, di basic and tri basic acid.

i. H_3PO_4 ii. CH_3COOH iii. NHO_3 iv. H_2SO_4 v. HCl

i. MONO BASIC ACID:

Acid that contains one acidic hydrogen per molecule is called mono basic acid.

Example: HCl, HNO_3, CH_3COOH, are mono basic acids.

ii. DI BASIC ACID (DI PROTIC ACID):

Acid that contains two acidic hydrogen per molecule is called di basic acid or di protic acid.

Example: H_2SO_4, is di basic or di protic acid.

iii. TRI BASIC ACID (TRI PROTIC ACID):

Acid that contains three acid hydrogen per molecule is called tri basic acid or tri protic acid.

Example: H_3PO_4, is tri basic or tri protic acid.

Q12. Write down the importance of pH. Also write the pH values of some biological fluids.

IMPORTANCE OF pH:

The concept of pH plays an essential role in the field of biology. For example, the pH of human blood is normally maintained by the body between 7.35 and 7.45 if the pH of blood drops to 7, as in some illness, the patient may go into coma, a pH below 6, death may occur, pH rises as high as 7.7 or 7.8 cause diabetes excess vomiting, diarrhea.

The pH values of some biological fluids.

Fluid	pH
Lemon juice	2.3
Vinegar	2.8
Tomato juice	4.2
Human urine	5.0 – 7.0
Cow's milk	6.5
Saliva	7.0
Human blood	7.35 – 7.45
Egg white	7.8

Q13. Numericals