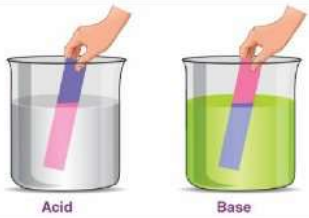
7
CHAPTER

ACID BASE CHEMISTRY



Student Learning Outcomes

After studying this chapter, students will be able to:

- Define Bronsted-Lowry acids as proton donors and Bronsted-Lowry bases as proton acceptors
- Recognize that aqueous solutions of acids contain ions and aqueous solutions of alkalis contain OH^- ions
- Define a strong acid and base as an acid or base that completely dissociates in aqueous solution and weak acid and base that partially dissociates in aqueous solution. (Some examples include: Student writing symbol equations to show these for hydrochloric acid, sulphuric acid, nitric acid, and ethanoic acid).
- Formulate dissociation equations for an acid or base in aqueous solution.
- Recognize that bases are oxides or hydroxides of metals and that alkalis are water soluble bases.
- Describe the characteristic properties of acids in terms of their reactions with metals bases and carbonates
- Identify the characteristic properties of bases in terms of their reactions with acids and ammonium salts Define acid rain.
- Discuss the effects of acid rain and relate them with properties of acids.

7.1 ACIDS AND BASES

LONG QUESTIONS

Q.1 (A) Write down characteristic properties of acids.
(B) Describe different classes of acids.

Ans: **(A) CHARACTERISTIC PROPERTIES OF ACIDS**

History of Acids

Acids and bases have been known to mankind since centuries.

GENERAL PROPERTIES OF BASES

(i) **Taste**

Acids have been known for their sour taste like the taste of lemon and ability to change the colour of litmus paper from blue to red.

Examples

There are many substances which contain acids and hence taste sour such as curd, tamarind, lemon and lime, etc.

(ii) **Touch**

Corrosive touch.

(iii) **Effect on litmus**

Have ability to change the colour of litmus paper from blue to red.

(iv) **Corrosive Nature**

Acids are corrosive in nature and can burn your skin away.

(v) **Metal Oxides**

Non-metals oxides are also acidic in nature because they react with bases to form salt and water.

Examples:

NO_2 is acidic oxide because it has strong tendency to react with water to produce hydrogen ions.

$$2NO_{2(s)} + H_2O \longrightarrow HNO_2 + HNO_3$$

Some common Examples of Acids

Common examples of acids include acetic acid, hydrochloric acid, nitric acid, sulphuric acid and tartaric acid.

Form of Solutions

Most of these acids, we come across in everyday life, are available in the form of aqueous solutions as they can be easily dissolved in water.

(B) CLASSIFICATION OF ACIDS

Acids are divided into two types on the basis of their occurrence:

(i) Natural acids
(ii) Mineral acids

(i) Natural acids

Acids which are obtained from natural sources are called natural or organic acids.

Examples

Common examples of mineral acids are hydrochloric acid, sulphuric acid and nitric acid.

Table 7.1: Some Common Organic acids and their natural Sources

Organic Acid	Natural Source
Acetic acid	Vinegar
Ascorbic Acid	Amla, Guava
Citric Acid	Lemon, Orange
Lactic Acid	Sour milk, Curd

Formic Acid	Ant sting
Oxalic Acid	Tomato
Tartaric Acid	Tamarind

(ii) Mineral acids

Mineral or man-made acids are prepared from minerals like sodium chloride or sodium nitrate.

Table 7.2: Some Common Mineral acids and their natural Sources

Mineral acids	Chemical Formula	Source
Hydrochloric acid	HCl	Mineral
Nitric Acid	HNO_3	Mineral
Nitrous Acid	HNO_2	-
Sulphuric Acid	H_2SO_4	Mineral
Sulphurous Acid	H_2SO_3	-
Hydrofluoric Acid	HF	Mineral
Hydrobromic Acid	HBr	Mineral

Q.2 Write down characteristic properties of bases. Also describe process of neutralization.

Ans: **ALKALIS OR BASES**

Base:

A substance which gives hydroxide ionsin aqueous solution is called an acid.

Akali:

An alkali is a base that dissolves in water.

Table 7.3: Some Common examples of bases are:

Organic acid	Chemical Formula
Potassium hydroxide (caustic potash)	KOH
Sodium hydroxide (caustic soda)	NaOH
Calcium hydroxide (lime water)	$Ca(OH)_2$
Aqueous ammonia	NH_4OH
Calcium hydroxide	$Ca(OH)_2$
Aluminium hydroxide	$Al(OH)_3$

GENERAL PROPERTIES OF BASES

(vi) **Taste**

In comparison to acids, alkalis or bases are known for their bitter taste,

(vii) **Touch**

slippery touch

(viii) **Effect on litmus**

ability to change the colour of litmus paper from red to blue

(ix) **Corrosive Nature**

Both sodium hydroxide and potassium hydroxide are extremely corrosive and can burn your skin away.

(x) **Metal Oxides**

Metals oxides are also basic in nature because they react with acids to form salt and water.

Examples:

Na_2O is basic oxide because it contains oxide ion, 0^2-, which is a very strong base with a strong tendency to react with water to produce hydroxide ions.

$$Na_2O\ (s) + H_2O_{(l)} \longrightarrow 2NaOH_{(aq)}$$

Other examples of basic oxides

- calcium oxide (CaO)
- zine Oxide (ZnO)
- magnesium oxide (MgO)

NEUTRALIZATION REACTION

Definition

NEUTRALIZATION REACITONS

Definition:

*"A reaction between an **acid** and a **base** is called a **neutralization** reaction. It produces a **salt and water**."*

Examples:

A few balanced chemical reactions are given here:

$$\text{Acid} + \text{Base} \longrightarrow \text{Salt} + \text{Water}$$

$$HCl_{(aq)} + NaOH_{(aq)} \longrightarrow NaCl_{(aq)} + H_2O_{(l)}$$

$$H_2SO_{4(aq)} + 2NaOH_{(aq)} \longrightarrow Na_2SO_{4_{(aq)}} + 2H_2O_{(l)}$$

$$CH_3COOH_{(aq)} + NaOH_{(aq)} \longrightarrow CH_3COONa_{(aq)} + H_2O_{(l)}$$

Process

Both acids and alkalis are known to cancel the properties of each other when mixed together in equal amounts. The reaction is called neutralization reaction.

Product

A salt and water are formed as a result of this reaction.

EXERCISE

Name some fruits which contain citric acid

Ans: **FRUITS CONTAINING CITRIC ACID**

Lemon, orange, limes, pineapples, tomatoes etc

INTERESTING INFORMATION

OXALIC ACID AND ITS USE

Oxalic acid ($H_2C_2O_4$) is the simplest organic diprotic acid. Its commercial uses include bleaching straw and leather and removing rust and ink stains from fabrics.

ACTIVITY 7.1

The following compounds are provided in the form of liquid or in the form of their aqueous solutions. Use blue and red litmus paper stripes to show whether these substances are acidic or basic in their aqueous solutions.

Substance	Acidic	Basic
Tap water	Acidic	-
Battery water	Acidic	
Rain water	Acidic	
Soap solution	-	Basic
Tooth paste	-	Basic
Shampoo	-	Basic
Bleach	-	Basic

SHORT QUESTIONS

Q.1 Which acid is present in stomach and how is stomach acidity treated? (*Understanding+Application Base)*

Ans:

ACID PRESENT IN STOMACH

We all have little concentration of hydrochloric acid in our stomach, which helps to break down the food. Sometimes the amount of stomach acid becomes too much, which causes acidity.

Treatment of Stomach Acidity:

Stomach acidity is easily treated by taking an alkaline medicine. The alkali neutralizes the acid, producing a harmless chemical called a salt.

Q.2 What are physical (characteristic) properties of acids? *(Knowledge Base)*

Ans:

PHYSICAL PROPERTIES OF ACIDS

The physical properties of acids are as follows:

- Acids have **sour taste**. e.g. Unripe citrus fruits or lemon juices.
- They turn **blue litmus red.**
- They are **corrosive** in concentrated form.
- Their aqueous solutions conduct electric current.

Examples:

- Hydrochloric acid **(HCl)**
- Sulphuric acid **(H_2SO_4)**
- Nitric Acid **(HNO_3)**

Q.3 What are physical (characteristic) properties of bases? *(Knowledge Base)* (GRW 2013, LHR 2015, BWP 2017)

Ans:

PHYSICAL PROPERTIES OF BASES

The physical properties of acids are as follows:

- Bases have **bitter taste** and feel slippery. e.g. Soap is slippery to touch.
- They turn **red litmus blue**.
- They are **non-corrosive except** concentrated forms of **NaOH and KOH**.
- Their aqueous solutions conduct electric current.

Examples:

- Sodium hydroxide **(NaOH)**
- Potassium Hydroxide **(KOH)**
- Calcium hydroxide **[$Ca(OH)_2$]**

Q.4 What is conjugate acid and conjugate base? *(Knowledge Base + Understanding Base)* (GRW 2013,2014,2015)

Ans:

CONJUGATE ACID AND CONJUGATE BASE

Conjugate Acid:

"*A conjugate acid is a **specie** formed by **accepting** a **proton** by a **base**".*

Conjugate Base:

"*A conjugate base is a **specie** formed by **donating** a proton by an **acid**".*

Examples:

- Conjugate means joined together as pair.

$$HCl + NH_3 \rightleftharpoons NH_4^+ + Cl^-$$

Acid + Base ⇌ Conjugate acid + Conjugate base

MULTIPLE CHOICE QUESTIONS

1. The first acid known to man was: *(K.B)* **(SWL 2017)**

(A) Hydrochloric acid (B) Sulphuric acid
(C) Nitric acid (D) Acetic acid

2. **The word acid is derived from:** ***(K.B)***
(A) Acidic (B) Acidus
(C) Acetic (D) Acetate

3. **CO_2 and SO_2 are:** ***(K.B)***
(A) Base (B) Acid
(C) Amphoteric compounds (D) Neutral compounds

4. **Which one gives acidic solution?** ***(K.B)***
(A) CO_2 (B) SO_2
(C) Both A and B (D) MgO

5. **The meaning of Latin word acidus is:** ***(K.B)*** **(DGK 2016 G-II)**
(A) Sweet (B) Tasteless
(C) Sour (D) Salty

6. **A reacton between an acid and a base is called:** ***(K.B)***
(A) Displacement (B) Decomposition
(C) Hydrolysis (D) Neutralization

7.2 DIFFERENT CONCEPTS OF ACIDS AND BASES

LONG QUESTIONS

Q.1 Describe Arrhenius Concept of Acids and Bases. (*Understanding+Application Base)*

Ans:

ARRHENIUS CONCEPT OF ACIDS AND BASES

Need of New Definitions of Acids and Bases

Although the earlier definitions of acids and bases describe some distinctive features of these substances, yet new and broader definitions were needed to explain their chemical behavior on the molecular level.

Introduction

Svante Arrhenius (1859-1927), a Swedish Chemist, suggested that acids and bases may be classified in terms of their behavior in water. According to him;

Arrhenius Acid

An acid is that substance which dissociates in water to give proton(H^+) or hydroxonium ion ($H_3O)^+$.

Examples

Some typical Arrhenius acids are:

- HCI
- HNO_3
- H_2SO_4
- HCN

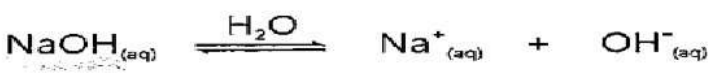
Arrhenius Base

A base is that substance which dissociates in water to give hydroxyl ions $(OH)^-$.

Examples

Some typical Arrhenius bases are:

- NaOH
- KOH
- $Ba(OH)_2$



Importance of water in Arrhenius Concept of acid and base

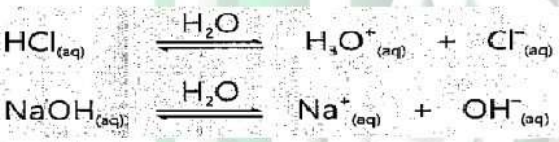
Water has an essential role to play in Arrhenius concept of acids and bases. Whenever an acid or a base dissociates in water, its molecules participate in reaction by surrounding the resultant proton (H^+) and hydroxyl ion(OH^-). Since proton is very small in size and its charge density is very high, it forms a strong bond with the lone pair of water molecule to give hydroxonium ion, H_3O^+.

Number of water molecules surrounding the proton (H^+)

According to some report upto four water molecules may surround the proton.

Similarly, hydroxyl ion are also surrounded by water molecules as shown in the figure (7.1)

Arrhenius also explained the process of neutralization. According to him when a strong acid and a strong base are dissolved in water, they completely dissociate into ions.

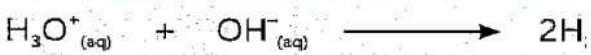


Spectator Ions

The ions which do not react and remain present in the solution are called spectator ions.

Example

The hydroxonium ion and the hydroxyl ion then react to form water with the evolution of heat.



The salt NaCI that is formed with water does not exist as solid crystals. It remains present in the solution as hydrated spectator sodium ions (Na^+) and chloride ions (Cl^-).

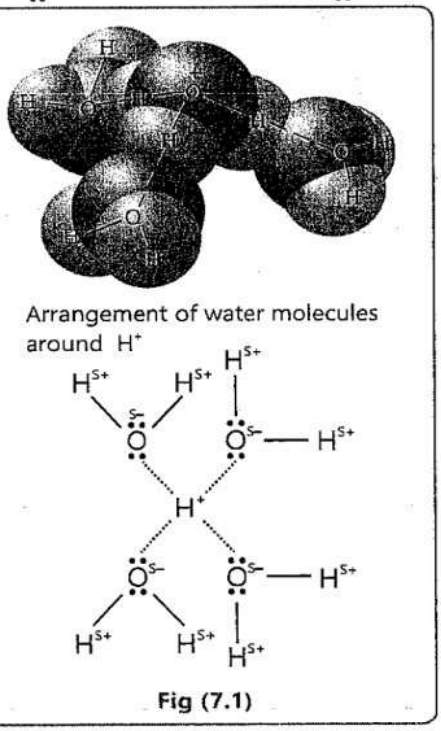
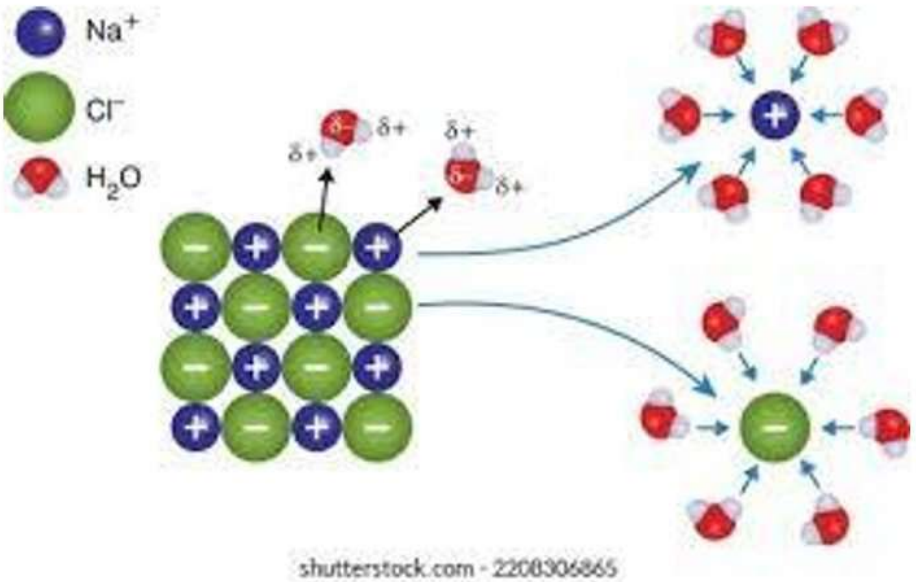
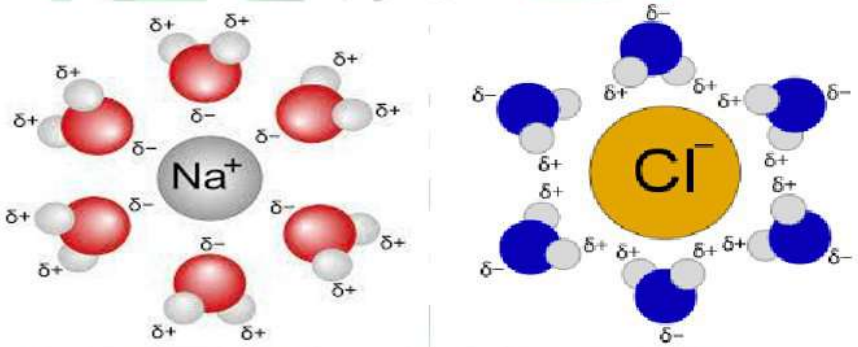


Fig (7.1)





STRENGTH OF ACIDS AND BASES

(a) Strength of Acids

Mineral acids are generally very strong acids.

The strength of an acid depends upon the extent to which it is ionized in water.

Strong Acid

An acid which ionizes completely in water is called strong acid.

Examples

1. Hydrochloric acid ionizes in water completely giving a large amount of hydronium ions in water.

$$HCl_{(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + Cl^-_{(aq)}$$

2. Sulphuric acid being a diprotic acid ionizes in two steps.

$$H_2SO_{4(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + HSO_4^-{}_{(aq)}$$

$$HSO^-_{4(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + SO_4^{2-}{}_{(aq)}$$

3. Nitric acid ionizes in single step.

$$HNO_{3(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + NO_3^-{}_{(aq)}$$

Weak Acid

An acid which ionizes incompletely in water is called weak acid.

Examples

Contrary to mineral acids, organic acids ionize upto a very limited extent and hence they are weak acids.

1. Glacial acetic acid has a percent ionization of only 0.132%.

$$CH_3COOH_{(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + CH_3COO^-_{(aq)}$$

It means that out of 100 molecules of acetic acid, only 1.32 molecules dissociate and the rest remain undissociated.

2. Similarly the percent ionization of formic acid having concentration 1.50M is 1.06%. Which means 987 molecules out of 1000 remain undissociated.

$$HCOOH + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + HCOO^-_{(aq)}$$

(b) Strength of Bases

The strength of a base depends upon the extent to which it is ionized in water.

Strong Base

A base which ionizes completely in water is called strong base.

Examples

NaOH and KOH are the examples of strong bases because they also ionize completely in water.

$$NaOH_{(aq)} \xrightleftharpoons{H_2O} Na^+ + OH^-_{(aq)}$$

Weak Base

A base which ionizes incompletely in water is called weak base.

Examples

NH_4OH and $Al(OH)_3$ are the examples of weak bases because they only partially ionize in water.

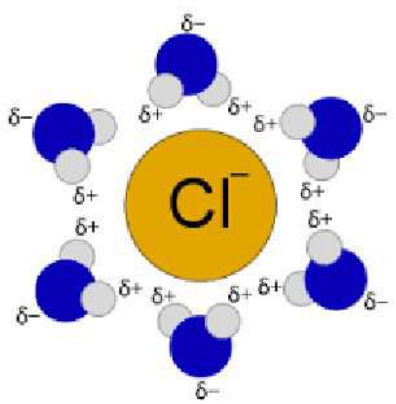
$$NH_4OH_{(aq)} \xrightleftharpoons{H_2O} NH^+_{4\,(aq)} + OH^-_{(aq)}$$

EXERCISE

How do chloride ions exist in water?

Ans: **EXISTENCE OF CHLORIDE IONS IN WATER**

Chloride exist in water as follows. Each chloride ion is surrounded by six water molecules and dispersed in water.



EXERCISE

Q. Why does ammonium hydroxide only partially ionize in water?
Ans: Ammonium hydroxide (NH_4OH) only partially ionizes in water because it is considered a weak base.

INTERESTING INFORMATION

STOMACH ACIDITY

Definition
Sometimes stomach produces too much acid. This condition is called stomach acidity or hyperacidity.
Stomach acidity or hyperacidity conditions are a common problem.

Most Common Cause of Stomach Acidity
Most often the problem arises when a person takes fatty and spicy foods which cause more acid to produce in the stomach than required.

Mechanism
Our stomach produces hydrochloric acid to digest the food that we eat., Whenever we eat, cells within the lining of the stomach produce acid. Problem occurs when these cells produce more acid than your stomach needs. When it happens, the person suffers from stomach acidity.

Symptoms
The common indication of such a condition is the feeling of burning sensation right below our breast bone.
A person may also feel sour taste in mouth and heart burn or pain near the heart area.

Treatment of Stomach Acidity
The uneasy condition may easily be cured by taking weak bases like:

- calcium hydroxide
- magnesium hydroxide

These are commonly known as antacids. These antacids remove minor stomach disorders by neutralizing the stomach acid.

Merits of Antacids
The concentration of hydroxyl ions in them is too low to harm the throat or stomach.

SHORT QUESTIONS

Q.1 What are physical (characteristic) properties of acids? *(Knowledge Base)*

Ans:

PHYSICAL PROPERTIES OF ACIDS

The physical properties of acids are as follows:

- Acids have **sour taste**. e.g. Unripe citrus fruits or lemon juices.
- They turn **blue litmus red.**
- They are **corrosive** in concentrated form.
- Their aqueous solutions conduct electric current.

Examples:

- Hydrochloric acid **(HCl)**
- Sulphuric acid **(H_2SO_4)**
- Nitric Acid **(HNO_3)**

Q.2 What are physical (characteristic) properties of bases? *(Knowledge Base)* (GRW 2013, LHR 2015, BWP 2017)

Ans:

PHYSICAL PROPERTIES OF BASES

The physical properties of acids are as follows:

- Bases have **bitter taste** and feel slippery. e.g. Soap is slippery to touch.
- They turn **red litmus blue**.
- They are **non-corrosive except** concentrated forms of **NaOH and KOH**.

- Their aqueous solutions conduct electric current.

Examples:

- Sodium hydroxide **(NaOH)**
- Potassium Hydroxide **(KOH)**
- Calcium hydroxide **[$Ca(OH)_2$]**

Q.3 What are limitations of Arrhenius concept of acids and bases? ***(Understanding Base)***
(GRW 2014, 15, DGK 2016 G-II, 17, MTN 2017, RWP 2017, FSD 2016 G-II)

Ans: Answer given on Page # 43

MULTIPLE CHOICE QUESTIONS

1. Formula of phosphoric acid is: ***(K.B)***

(A) H_2PO_3 (B) H_4PO_3
(C) HPO_4 (D) H_3PO_4

2. $Al(OH)_3$ is: ***(K.B)***

(A) An acid (B) A base
(C) A salt (D) A non-metallic oxide

3. The final product of Arrhenius concept is: ***(U.B)***

(A) Salt +H_2O (B) An adduct
(C) A conjugate acid base pair (D) A salt only

4. Base turn red litmus to: ***(K.B)***

(A) Blue (B) Red
(C) White (D) Yellow

5. It is a substance which provides hydrogen ions: ***(K.B)***

(A) Acid (B) Base
(C) Salt (D) Adduct

6. It is a substance which provides hydroxide ions: ***(K.B)***

(A) Acid (B) Base
(C) Salt (D) Adduct

7.3 BRONSTED-LOWRY CONCEPTS OF ACIDS AND BASES

LONG QUESTIONS

Q.1 Explain Bronsted-Lowry Concept. Give its limitations. ***(Knowledge + Understanding Base)***
OR
Define an acid and a base according to Bronsted-Lowry concept and justify with examples that water is an amphoteric compound.

Ans:

BRONSTED-LOWRY CONCEPT

Introduction

Limitations of Arrhenius Concept

i. Arrhenius concept of acids and bases is very simple and easily understandable but it has got its limitations.

Example

ii. Na_2CO_3, K_2CO_3 and NH_3 do not contain any hydroxyl group which will get ionized by water but all these compounds behave as bases and yield OH^- in water.

iii. Arrhenius definitions also require that water must be present as a solvent in order for a compound to behave as an acid or a base.

iv. It was realized that a broader definition for acids and bases is needed to cover all the aspects of the concept.

v. To remove the limitation of Arrhenius concept, Bronsted and Lowy gave the following definition of acids and bases.

BRONSTED-LOWRY BASE

Definition

An acid is a substance that donates a proton.

This definition requires that to behave as an acid a compound must have a proton to donate. The condition of the presence of water during this donation was, however, eliminated.


Johannes N. Bronsted (1879-1947) Thomas M. Lowry (1874-1936)

Arrhenius acids as Bronsted-Lowy acids

All Arrhenius acids are, thus Bronsted-Lowy acids as well

Example

HCl, HBr etc.

They dissolves in water to give H^+ and Cl^-. It also donates H^+, H_2O forming H_3O^+.

BRONSTED-LOWRY BASE

Definition

A base is a substance that accepts a proton.

Example

OH], CN-, NH3 and Cl- are all bases because they have the ability to accept a proton. Note that except OH- all other species are not Arrhenius bases.

Arrhenius bases as Bronsted-Lowry bases

All Arrhenius bases are, however, Bronsted-Lowry bases as well.

All Bronsted-Lowry acids and bases are not Arrhenius acids and bases. NH_4^+ is not Arrhenius acid and NH_3 is not Arrhenius base.

Acid base reaction according to Bronsted-Lowry

According to Bronsted-Lowry, an acid base reaction is that reaction in which a proton is transferred from a proton donor to its acceptor. This reaction may take place in gas phase or in the presence of any solvent.

Examples

(i) Consider the following reaction between hydrogen chloride gas and liquid water.

$$\underset{\text{Acid}}{HCl_{(g)}} + \underset{\text{Base}}{H_2O_{(l)}} \rightleftharpoons H_3O^+_{(aq)} + Cl^-$$

In this reaction, HCI gas acts as an acid because it donates its proton to water which acts as a base.

(ii) Similarly, when ammonia gas dissolves in water, a proton is transferred from water to ammonia and ammonium ion is formed.

$$\underset{\text{Base}}{NH_{3(g)}} + \underset{\text{Acid}}{H_2O_{(l)}} \rightleftharpoons \underset{\text{Conjugate base}}{OH^-_{(aq)}} + \underset{\text{Conjugate acid}}{NH_4^+{}_{(aq)}}$$

Ammonia is a base while water is an acid in this reaction.

Amphoteric Compound

A compound which can behave as an acid as well as a base is called amphoteric compound.

Examples

H_2O, Al_2O_3, ZnO etc

Water as amphoteric Compound

$$\underset{\text{Base}}{NH_{3(g)}} + \underset{\text{Acid}}{H_2O_{(l)}} \rightleftharpoons \underset{\text{Conjugate base}}{OH^-_{(aq)}} + \underset{\text{Conjugate acid}}{NH_4^+{}_{(aq)}}$$

$$\underset{\text{Acid}}{HCl_{(g)}} + \underset{\text{Base}}{H_2O_{(l)}} \rightleftharpoons H_3O^+_{(aq)} + Cl^-$$

Water has the ability to act both as an acid or a base depending upon the other compound with which it reacts.

Water is therefore called an amphoteric compound which means a compound that can behave both as an acid and a base.

Conjugate Acid and Conjugate Base

Conjugate Acid:

"*A conjugate acid is a **specie** formed by **accepting** a **proton** by a **base**".*

Conjugate Base:

"*A conjugate base is a **specie** formed by **donating** a **proton** by an **acid**".*

Examples:

- Conjugate means joined together as pair.

$$\underset{\text{Acid}}{CH_3COOH} + \underset{\text{Base}}{H_2O} \rightleftharpoons \underset{\text{Conjugate acid}}{CH_3COO^-} + \underset{\text{Conjugate base}}{H_3O^+}$$

$$\underset{\text{Base}}{NH_{3(g)}} + \underset{\text{Acid}}{H_2O_{(l)}} \rightleftharpoons \underset{\text{Conjugate base}}{OH^-_{(aq)}} + \underset{\text{Conjugate acid}}{NH_4^+{}_{(aq)}}$$

In the reverse reaction, OH^- is a base because it accepts a proton donated by the acid NH_4+. In order to differentiate, OH^- is called the conjugate base while $NH4^+$ the conjugate acid.

Some other Bronsted-Lowry acids and bases

Some other examples of Bronsted-Lowry acids and bases.

$$\underset{\text{Acid}}{HCN_{(aq)}} + \underset{\text{Base}}{H_2O_{(l)}} \rightleftharpoons \underset{\text{Conjugate acid}}{H_3O^+_{(aq)}} + \underset{\text{Conjugate base}}{CN^-_{(aq)}}$$

$$\underset{\text{Acid}}{HI_{(aq)}} + \underset{\text{Base}}{H_2O_{(l)}} \rightleftharpoons \underset{\text{Conjugate acid}}{H_3O^+_{(aq)}} + \underset{\text{Conjugate base}}{I^-_{(aq)}}$$

EXERCISE

Q. Give two examples of Bronsted-Lowry bases which are not bases by Arrhenius definition.

And: **BRONSTED-LOWRY BASES BUT NOT ARRHENIUS BASES**

(i) Ammonia: NH_3

(ii) Phosphine: PH_3

SHORT QUESTIONS

Q.1 What is conjugate acid and conjugate base? *(Knowledge Base + Understanding Base)* (GRW 2013,2014,2015)

Ans: **CONJUGATE ACID AND CONJUGATE BASE**

Conjugate Acid:

"*A conjugate acid is a **specie** formed by **accepting** a **proton** by a **base**".*

Conjugate Base:

"*A conjugate base is a **specie** formed by **donating** a proton by an **acid**".*

Examples:

- Conjugate means joined together as pair.

$$HCl + NH_3 \rightleftharpoons NH_4^+ + Cl^-$$

Acid + Base Conjugate acid + Conjugate base

Q.2 What are limitations of Bronsted-Lowry concept of acids and bases? *(Knowledge Base)*

Ans: Answer given on Page #

MULTIPLE CHOICE QUESTIONS

1. Formula of phosphorous acid is: *(K.B)*

(A) H_2PO_3 (B) H_3PO_3

(C) HPO_4 (D) H_3PO_4

2. $Fe(OH)_3$ is: *(K.B)*

(A) An acid (B) A base

(C) A salt (D) A non-metallic oxide

3. The final product of Bronsted-Lowry concept is: *(U.B)*

(A) Salt $+H_2O$ (B) An adduct

(C) A conjugate acid base pair (D) A salt only

4. Acids turn red litmus to: *(K.B)*

(A) Blue (B) Red

(C) White (D) Yellow

5. Which one is amphoteric: *(U.B)*

(A) HCl (B) NH_3

(C) NaOH (D) H_2O

6. Bronsted Lowry acid: *(K.B)*

(A) Gives H^+ (B) Is an electron pair acceptor

(C) Donates OH^- (D) Is an electron pair

7. All Bronsted acids are: *(U.B)*

(A) Arrhenius acids (B) Lewis acids

(C) Lewis bases (D) Bronsted acids

8. Conjugate base of sulphuric acid is: *(U.B)* **(LHR 2014, BWP 2017)**

(A) SO_3^{2-} (B) SO^{2-}

(C) HSO_3^- (D) HSO_4^-

9. Acid is a substance that can donate a: *(K.B)*

(A) Proton (B) Electron

(C) Neutron (D) Positron

10. Bronsted-Lowry concept is based on transfer of: ***(K.B)***

(A) Proton (B) Electron

(C) Neutron (D) Positron

11. Substances that can behave as acid as well as base are called: ***(K.B)***

(A) Bases (B) Acids

(C) Amphoteric compounds (D) Salts

12. Which one is not an acid? ***(K.B)*** **(MTN 2016 G-II)**

(A) HCl (B) NH_3

(C) H_2CO_3 (D) H_2SO_4

7.4 PROPERTIES OF ACIDS AND BASES

LONG QUESTIONS

Q.1 (a) Explain the chemical properties of acids? ***(Understanding + Application Base)***

(b) Explain the chemical properties of bass? ***(Understanding + Application Base)***

Ans:

CHEMICAL PROPERTIES OF ACIDS

(a) Acids give the following three types of reactions.

1. Reaction of Acid with Alkalis or metal oxides

With alkalis or metal oxides, they form salts and water.

$$2HNO_3(aq) + CaO(s) \longrightarrow Ca(NO_3)_2(aq) + H_2O(l)$$

$$H_2SO_4(aq) + 2KOH(aq) \longrightarrow K_2SO_4(aq) + 2H_2O(l)$$

2. Reaction of Acids metals

(a) With reactive metals (Mg, Zn)

With reactive metals (Mg, Zn) they form salts and evolve hydrogen gas.

$$Mg(s) + 2HCl(aq) \longrightarrow MgCl_2(aq) + H_2(g)$$

$$Zn(s) + H_2SO_4(aq) \longrightarrow ZnSO_4(aq) + H_2(g)$$

With unreactive metals (Cu, Ag, Au, and Pt)

The unreactive metals Cui Ag, Au, and Pt do not evolve hydrogen gas with acids.

3. Reaction of Acid with Carbonates and hydrogen carbonates

They decompose metal carbonates and hydrogen cabonates evolving carbon dioxide gas.

$$CaCO_3(s) + 2HCl(aq) \longrightarrow CaCl_2(aq) + H_2O(1) + CO_2(g)$$

$$2NaHCO_3(s) + H_2SO_4(aq) \longrightarrow Na_2SO_4(aq) + 2H_2O(1) + 2CO_2(g)$$

ACTIVITY 7.2

Take a few granules of zinc in a clean test tube. Add dilute H_2SO_4 in and heat it gently, Identify the gas evolved in this reaction by taking burning match stick near the mouth of test tube. Note the observations in your notebook.

Observations

(b) **PROPERTIES OF ALKALIS**

As already mentioned alkalis are those bases which are soluble in water. Examples of alkalis are NaOH, KOH etc.

$Ca(OH)_2$ is sparingly soluble in water while $Cu(OH)_2$ is insoluble.

1. Reaction of Base with Acids (Neutralization reaction)

$$NaOH(aq) + HCl(aq) \longrightarrow NaCl(aq) + H_2O(l)$$

$$Ca(OH)_2 + H_2SO_4(aq) \longrightarrow CaSO_4(aq) + 2H_2O(l)$$

Reaction of Base with ammonium salts

Apart from reacting with acids in neutralization reactions, alkalis also react with ammonium salts and liberate ammonia gas

$$Ca(OH)_2(aq) + 2NH_4Cl(aq) \longrightarrow CaCl_2(aq) + 2H_2O(l) + 2NH_3(g)$$

$$NaOH(aq) + NH_4NO_3(aq) \longrightarrow NaNO_3(aq) + H_2O(l) + NH_3(g)$$

ACTIVITY 7.3

HOW TO CLEAN A BLOCKED DRAIN?

Blocked drains are one of the most common problems that we face every other day.

Removal of Blockage of Drains

Different blockages require different chemicals to remove them.

Methods

(i) General Method (Using $NaHCO_3$ and vinegar)

One of the ways to clean the drain is to pour half a cup of sodium bicarbonate solution into the drain followed by half a cup of vinegar. Cover the drain and wait for thirty minutes. Pour boiling water down the drain.

(ii) Caustic chemical drain cleaners

Pour down the caustic cleaner into your drain. Wait for half an hour and then flush your drain with water.

Application of Caustic cleaners

Caustic chemical drain cleaners are capable of dissolving grease, hair, food and other common blockages.

SHORT QUESTIONS

Q.1 What are mineral acids? ***(Knowledge Base)*** **GRW 2015)**

OR

Write down the names and formulae of three mineral acids.

Ans: **MINERAL ACIDS**

Definitions:

"Acids having ***inorganic origin*** *are called mineral acids".*

Examples

- Hydrochloric acid (HCl)
- Sulphuric acid (H_2SO_4)
- Nitric acid (HNO_3)

Q.2 How do acids react with metals? ***(Application Base)***

Ans: **REACTION BETWEEN ACIDS AND METALS**

Acids react explosively with metals like sodium, potassium and calcium. However, dilute acids (HCl, H_2SO_4) react moderately with reactive metals like, Mg, Zn, Fe and Al to form respective salts and evolve hydrogen gas.

$$Zn_{(s)} + H_2SO_{4(aq)} \longrightarrow ZnSO_4 + H_{2(g)}$$

$$2Al_{(s)} + 6HCl_{(aq)} \longrightarrow 2AlCl_{3(aq)} + 3H_{2(g)}$$

Q.3 Write down uses of hydrochloric acid. ***(Knowledge Base)***

Ans: **USES OF HYDROCHLORIC ACID**

It is used:

- For cleaning metals
- For tanning
- In printing industries.

Q.4 Give the uses of sulphuric acid. ***(Knowledge Base)*** **(MTN 2016 G-I)**

Ans: **USES OF SULPHURIC ACID**

Sulphuric acid (H_2SO_4) is used:

- To manufacture fertilizers, ammonium sulphate, calcium superphosphate, etc.
- To prepare explosives, paints, dyes, drugs.
- As an electrolyte in lead storage batteries.

Q.5 Write down any two uses of acetic acid. ***(Knowledge Base)*** **(SWL 2016 G-I)**

Ans: **USES OF ACETIC ACID**

Acetic acid is used:

- In food preservation, flavouring of food.
- To treat stings of wasps.

Q.6 Write the name of acid present in (a) Vinegar (b) Ant sting. ***(Knowledge Base)*** **(DGK 2016 G-I)**

Ans: **NAMES OF ACIDS**

The names of acids present in vinegar ant sting are:

- Vinegar : Acetic acid
- Ant sting : Formic acid

Q.7 How do acids react with carbonates and bicarbonates? ***(Application Base)***

Ans: **REACTION OF ACIDS AND CARBONATES AND BICARBONATES**

They decompose metal carbonates and hydrogen cabonates evolving carbon dioxide gas.

$$CaCO_3\,(s) + 2HCl\,(aq) \longrightarrow CaCl_2\,(aq) + H_2O\,(1) + CO_2\,(g)$$

$$2NaHCO_3\,(s) + H_2SO_4\,(aq) \longrightarrow Na_2SO_4(aq) + 2H_2O(1) + 2CO_2\,(g)$$

MULTIPLE CHOICE QUESTIONS

1. $Ca(OH)_2$ is: ***(K.B)***
(A) An acid (B) A base
(C) A salt (D) A non-metallic oxide

2. Neutralization is reaction of: ***(U.B)***
(A) Acids with metals (B) Acids with sulphides
(C) Bases with acids (D) None of these

2. Acid used for food preservation is: ***(K.B)***
(A) Nitric acid (B) Benzoic acid
(C) Acetic acid (D) Both B and C

3. Formula of acetic acid is: ***(K.B)***
(A) CH_3COOH (B) CH_2O
(C) NaOH (D) CH_3OH

4. When acids react with carbonates and bicarbonates, which gas evolves out? ***(U.B)*** **(LHR 2013,14, GRW 2014, SWL 2017)**
(A) H_2S (B) CO_3
(C) CO_2 (D) CO

5. Uric acid is present in: ***(K.B)*** **(FSD 2016 G-I, SGD 2016 G-I)**
(A) Fats (B) Citrus fruits
(C) Apples (D) Urine

6. When Na reacts with HCl the salt produced is: ***(U.B)***
(A) NaCl (B) NaOH
(C) H_2O (D) NH_3

7. Citric acid is found in: ***(K.B)*** **(BWP 2017, FSD 2016 G-II)**
(A) Urine (B) Fast
(C) Lemon (D) Sour milk

8. Name the acid used in lead storage batteries: ***(K.B)*** **(MTN 2017, SGD 2017)**
(A) CH_3COOH (B) HCl
(C) HNO_3 (D) H_2SO_4

7.5 ACID RAIN AND ITS EFFECTS

LONG QUESTIONS

Q.1 Explain how rain water is acidic and what are the effects of acidic rain?
(Knowledge+Understanding Base)

How rain water is acidic?

OR

Define acid rain. How it forms and what are its effects? **(LHR 2014, 15)**

Ans: **ACID RAIN**

Definition:

"A rain having a pH lower than that of ***normal rain water*** *due to the presence of H_2SO_4 and HNO_3 is called acid rain".*

OR

When rain water has pH less than 5.6, it is called acid rain.

pH of acid rain can be as low as 2.5.

pH of normal rain water

pH of normal rain water is 5.6 to 6.0 (weakly acidic) due to the dissolved carbon dioxide in it.

Formation of Acid Rain

Burning of fossil fuels releases harmful gases in air. These gases, SO_3 and NO_2 when mixed with moisture present in air form acid droplets. These droplets then fall on the ground as acid rain.

Reactions

$$2SO_{2(g)} + O_{2(g)} \longrightarrow 2SO_{3(g)}$$

$$SO_{3(g)} + H_2O_{(l)} \longrightarrow H_2SO_{4(aq)}$$

$$2NO_{2(g)} + H_2O_{(l)} \longrightarrow HNO_{3(g)} + HNO_{2(g)}$$

EFFECTS OF ACID RAIN

Acid rain causes a number of adverse effects on:

i. soil
ii. plants
iii. aquatic life
iv. human-made structures

i. Increase in Acidity of soil

Acid rain makes soil more acidic. It dissolves and washes away nutrients present in the soil which are needed by plants. Many plants cannot five or grow in an acidic soil.

ii. Damage to the vegetation and plants

It can damage vegetation and plants.

iii. Damage to the aquatic life

Acid rain can make water of the water bodies too acidic for aquatic animals to live in. Due to this many lakes, rivers, ponds and streams no longer have fish.

iv. Damage to the buildings and monuments

Acid rain and the dry deposition of acidic particles damage buildings, statues, automobiles and other structures made of stone and metal.

SHORT QUESTIONS

Q.1 What is meant by acid rain? ***(Knowledge Base)***

Ans: **ACID RAIN**

Definition:

"A rain having a pH lower than that of natural rain due to the presence of H_2SO_4 and HNO_3 is called acid rain".

Formation:

Burning of fossil fuels produces oxides of sulphur and nitrogen in air. Rain water converts SO_2 into H_2SO_4 and NO_x to HNO_2 and HNO_3.

Q.2 How does aluminium harm the fish? ***(Knowledge Base)*** **(RWP 2017)**

Ans: **HARM OF ALUMINIUM TO THE FISH**

High concentration of aluminium metal clogs fish gills. It causes suffocation and ultimately death of fish.

Q.3 How acid rain is produced? ***(Knowledge Base)*** **(GRW 2013, SWL 2016 G-I, 17, SGD 2017)**

Ans:

PRODUCTION OF ACID RAIN

Definition:

"*Acid rain means the presence of excessive acids in rain waters".*

Production:

This rain is produced when normal rain water dissolves oxides of sulphur and nitrogen in air. The rain water converts SO_2 into H_2SO_4, NOx into HNO_2 and HNO_3.

Q.4 Why acid rain damages buildings? ***(Knowledge Base)*** **(GRW 2014, FSD 2016 G-II)**

Ans:

ACID RAIN DAMAGES BUILDINGS

Acid rain attacks the calcium carbonate present in the marble and limestone of buildings and monuments. Thus, these buildings are getting dull and eroded day by day.

Q.5 How aquatic life is affected by acid rain? ***(Knowledge Base)***

Ans:

EFFECTS OF ACID RAIN

Acid rain on soil and rocks dissolves heavy metals (Al, Hg, Pb, Cr, etc.) with it and discharges these metals into rivers and lakes. The high concentration of these metals, especially high concentration of aluminium metal clogs the fish gills. It causes suffocation and ultimately death of fish.

Q.6 Why plants are dying day by day? Comment. ***(Knowledge Base)***

OR

How acid rain affect the trees and plants? **(GRW 2017)**

Ans:

DYING OF PLANTS DAY BY DAY

Acid rain directly damages the leaves of trees and plants, thus limiting their growth. Depending upon the severity of the damage plants growth can be hampered. Plants capability to bear cold or diseases reduces and ultimately die.

MULTIPLE CHOICE QUESTIONS

1. Which one is heavy metal? ***(K.B)***

(A) Na (B) Hg

(C) K (D) Both A and C

2. Buildings are being damaged by acid rain because it attacks: ***(K.B)*** **(SWL 2017)**

(A) $CaSO_4$ (B) $Ca(NO_3)_2$

(C) $CaCO_3$ (D) CaC_2O_4

3. pH of normal rain water is: ***(K.B)***

(A) 5.6 to 6 (B) 6 to 7

(C) 8 (D) 9

4. pH of acid rain is: ***(K.B)***

(A) 7 (B) 5

(C) 6 (D) 3

5. Acid rain attacks on: ***(K.B)***

(A) $CaCO_3$ (B) K_2CO_3

(C) Na_2CO_3 (D) HNO_3

ANSWER KEY

MULTIPLE CHOICE QUESTIONS

7.1 ACIDS AND BASES

1	D	**2**	B	**3**	B	**4**	C	**5**	C
6	D								

7.2 DIFFERENT CONCEPTS OF ACIDS AND BASES

1	A	2	B	3	A	4	A	5	A
6	B								

7.3 BRONSTED – LOWRY CONCEPTS OF CIDS AND BASES

1	B	2	B	3	A	4	B	5	D
6	A	7	A	8	D	9	A	10	A
11	C	12	B						

7.4 PROPERTIES OF ACIDS AND BASES

1	B	2	C	3	B	4	A	5	C
6	D	7	A	8	C	9	D		

7.5 ACID RAIN AND ITS EFFECTS

1	B	2	C	3	A	4	D
5	A						

EXERCISE SOLUTION

MULTIPLE CHOICE QUESTIONS

1 Tick () the correct answer.

1. Which acid is not used as a food or mixed with food?

(A) Tartaric acid (B) Ascorbic acid
(C) Citric acid (D) Formic acid

2. While baking, which gas is responsible for raising the bread and making it soft?

(A) Oxygen (B) Carbon dioxide
(C) Nitrogen (D) Carbon monoxide

3. Predict the main characteristics of the reactions of metals with acids.

(A) Metals are dissolved
(B) Metals are converted into salts
(C) Hydrogen gas is evolved
(D) All the above mentioned characteristics are true

4. How many hydroxide ions, calcium hydroxide will release in water?

(A) 1 (B) 2
(C) Zero (D) 3

5. In a neutralization reaction between KOH and H_3PO_4, how many molecules of KOH will react with one molecule of H_3PO_4?

(A) 2 (B) 1

(B) 3 (D) 4

6. Which acid is used for the preparation of soap?

(A) Tartaric acid (B) Citric acid

(C) Stearic acid (D) Oxalic acid

7. Which compound is formed when SO_2 is dissolved in water?

(A) SO_3 (B) H_2SO_3

(C) H_2SO_4 (D) $H_2S_2O_7$ (viii)

8. Which of the following contains oxalic acid?

(A) Tomato (B) Orange

(C) Tamarind (D) Sour milk

9. Which compound in the following reaction is behaving as a conjugate base?

$CH_3COOH_{(aq)} + H_2O_{(l)} \rightleftharpoons CH_3COO^-_{(aq)} + H_3O^+_{(aq)}$

(A) CH_3COOH (B) H_2O

(B) CH_3COO (D) H_30^+

10. When a chemical reaction is carried out with a substance Z; a gas is produced which turns red litmus paper blue. What is the reaction?

(A) Reaction of an acid with a metal carbonate

(B) Reaction of an acid with ammonium salt

(C) Reaction of an alkali with a metal carbonate

(D) Reaction of an alkali with ammonium salt

ANSWER KEY

1	D	2	B	3	D	4	B	5	C
6	C	7	B	8	A	9	C	10	D

FOR SHORT ANSWERS

2. Questions for Short Answers

Q.1 Choose Arrhenius Acids among the following compounds.

$HF,\ NH_4^+,\ H_2SO_3,\ SO_3,\ H_2S,\ H_2O$

Ans: **ARRHENIUS ACIDS**

HF, NH_4^+, H_2SO_3, H_2S, H_2O

Q.2 How does calcium metal reacts with dilute H_2SO_4?

Ans: **REACTION OF Ca WITH H_2SO_4**

Calcium metal reacts with dilute H_2SO_4 and forms calcium sulphate and hydrogen gas.

Q.3 Which salt is formed when HCI reacts with $BaCO_3$?

Ans: **REACTION OF HCI with $BaCO_3$**

$BaCl_2$ is formed when HCI reacts with $BaCO_3$.

Q.4 How will you justify that HSO_4^- is a Bronsted-Lowry acid?

Ans: **HSO_4^- IS A BRONSTED-LOWRY ACID**

HSO_4^- is considered a Bronsted-Lowry acid because it can donate a proton (H+) to another molecule.

Q.5 What chemical name will you give to soap as a compound?

Ans: **CHEMICAL NAME OF SOAP**

Chemical name of soap is sodium stearate ($C_{17}H_{35}COONa$). It is a sodium salt of a long-chain fatty acid. It is formed through a process called saponification.

CONSTRUCTED RESPONSE QUESTIONS

3. Constructed Response Questions

Q.1 Why is HCI not edible although it is present in the stomach and responsible for digestion of food?

Ans: **HCI IS NOT EDIBLE**

Hydrochloric acid (HCl) is not edible because it is corrosive and can damage the stomach lining.

Q.2 In the presence of a drop of an acid, water is known to ionize as follows:

a. $H_2O_{(l)} \rightleftharpoons OH^- + H^+$

In your opinion, which name will be suitable for water: an acid, a base or both?

Ans: **SUITABLE NAMES**

Water can act both as an acid as well as base therefore it will be called an amphoteric compound.

Q.3 Why does Na_2CO_3 behave like a base in water?

Ans: **Na_2CO_3 AS A BASE IN WATER**

Sodium carbonate (Na_2CO_3) behaves like a base in water because when it dissolves in water, the carbonate ion (CO_3^{2-}) easily accepts hydrogen ions (H^+) from water molecules and produce hydroxide ions (OH^-). Hydroxide ions (OH^-) make the solution basic.

Q.4 Is $NaHCO_3$ a base or an acid?

Ans: **$NaHCO_3$ A BASE OR AN ACID**

NaHCO3, also known as sodium bicarbonate or baking soda, is considered a base. When it is dissolved in water, it produces a weak alkaline solution.

Q.5 What is the difference between a strong acid and a concentrated acid?

Ans: **DIFFERENTIATION**

The differences between strong acid and a concentrated acid are as follows:

Strong Acid	Concentrated Acid
Definition	
• *An acid which ionizes completely in aqueous solution is called a strong acid.*	• *An acid which is relatively more concentrated is called a concentrated acid.*
Examples	
• HCl, HNO_3, H_2SO_4	• 18 M H_2SO_4 solution

DESCRIPTIVE QUESTIONS

4. Descriptive Questions

Q.1 Explain Arrhenius concept of acids and bases.

Ans: Answer given on page # 185

Q.2 Compare Arrhenius and Bronsted-Lowry concepts of acids and bases.

Ans: Answer given on page # 192

Q.3 How does sulphuric acid react with the following compounds?
NH_4CI, NH_4NO_3, MgO, $MgCO_3$

Ans: **REACTIONS OF SULPHURIC ACID**

$$2\ NH_4Cl_{(aq)} + H_2SO_{4(aq)} \rightarrow (NH_4)_2SO4_{(aq)} + 2HCl_{(aq)}$$

$$2NH_4NO_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4 + 2HNO_3$$

$$MgO + H_2SO_4 \longrightarrow MgSO_4 + H_2O$$

$$MgCO_3 + H_2SO_4 \longrightarrow MgSO_4 + H_2O + CO_2$$

Q.4 What happens when a base reacts with a non-metallic oxide? What do you infer about the nature of non-metallic oxide?

Ans: **REACTION OF BASE WITH NON-METALLIC OXIDE**

When a base reacts with a non-metallic oxide a salt and water are formed.

NATURE OF NON-METALLIC OXIDES

From this reaction we can infer that non-metallic oxides are acidic in nature as they react with base to form salt and water.

Q.5 State the reason of showing acidic character by both dry HCI gas and HCI solution in water.

Ans: **ACIDIC CHARACTER OF DRY HCI GAS AND HCl SOLUTION**

Amongst dry HCl gas and HCl solution, HCl solution will show acidic properties. This is due to the reason that dry gas does not ionize to give hydrogen ions and thus cannot act as an acid. On the other hand, HCl in solution gives hydrogen ions which are responsible for the acidic character of HCl.

Q.6 Differentiate between an acid and its conjugate base.

Ans: : **DIFFERENTIATION**

The differences between acid and a conjugate base are as follows:

Acid	Conjugate Base
• ***A substance which dissociates in aqueous solution to give hydrogen ions is called an acid.***	• *Abase formed by donating proton by an acid is called conjugate base.*
Key Difference	
• It has tendency to give hydrogen ion.	• It has tendency to gain hydrogen ion.

INVESTIGATIVE QUESTIONS

5. Investigative Questions

Q.1 Acids play significant roles within human body. Comment on this statement.

Ans: **ROLE OF ACIDS IN HUMAN BODY**

Acids play significant roles within human body.

Examples

(i) **Digestion of Food**

Acids helps in digestion of food. The food we eat is broken down in the stomach by the enzyme pepsin and other digestive juices. Pepsin works well in acidic medium. The acid in our stomach is important because it helps to digest our food.

(ii) **Killing of Bacteria**

It also kills bacteria that may be present in our food. The acid in our stomach is called hydrochloric acid (HCl).

Q.2 **What is observed when CO_2 is passed through lime water**

(i) for a short duration

(ii) fora long duration?

Ans: **PASSING OF CO_2 THROUGH LIME WATER**

(i) for a short duration

When carbon dioxide (CO_2) is passed through lime water, for a short duration it turns milky due to the formation of a white precipitate of calcium carbonate ($CaCO_3$).

(ii) fora long duration

When carbon dioxide (CO_2) is passed through lime water for a long duration, the milkiness disappears because the precipitate dissolves to form soluble calcium bicarbonate, $Ca(HCO_3)_2$, and thus forms a clear solution.

TERMS TO KNOW

Terms	Definitions
Acids	**Acids** are those compounds which have a sour taste and which turn blue litmus red. They also give hydroxonium ions-when dissolved in water.
Bases or alkalis	**Bases or alkalis** are those compounds which are bitter in taste, have a slippery touch and which change red litmus blue. They also form hydroxide ions when dissolved in water.
Neutralization reaction	In a **neutralization reaction**, an aqueous solution of an acid reacts with an aqueous solution a base to give salt and water.
Arrhenius acids	According to Arrhenius definitions, acids give protons in water.
Arrhenius bases	Arrhenius bases give hydroxide ions in water.
Bronsted-Lowry acid	Bronsted-Lowry define acid as a proton donor.
Bronsted-Lowry base	Bronsted-Lowry base as proton acceptor.
Properties of Acids	Generally, acids dissolve metals with the evolution of hydrogen. gas. They also decompose carbonates and hydrogen carbonates.
Properties of Bases	Generally alkalis or bases react-with ammonium salts to evolve ammonia gas.