CHAPTER 10

ACIDS, BASES AND SALTS

TOPICAL MULTIPLE CHOICE QUESTIONS

Q.No.1 Encircle the correct option from the given multiple choices.

Concept of Acids and Bases

(1) The Aqueous solutions of Both Acid and Bases are

(a) Conductor of electricity
(b) Bad Conductor of electricity
(c) Semi- Conductor
(d) all of these

Arrhenius Concept

(2) A Swedish Chemist Svonte Arrhenius proposed the first successful theory on acid and Bases in

(a) 1787 (b) 1896 (c) 1887 (d) 1987

(3) An Acid is a substance that ionizes in water to produce H^+ and base is a substance that ionizes in water to produce OH^- ions This is the statement of

(a) Lewis Acid Base Concept
(b) Arrhenius Acid Base Concept
(c) Lowry Bronsted Acid Base Concept
(d) Lavoisier Concept

Bronsted-Lowry Concept

(4) Lowery and Bransted put forward their concept in

(a) 1924 (b) 1923 (c) 1887 (d) 1921

(5) According to which concept acid is proton donor and base is proton accepter

(a) Arrhenius Concept (b) Lewis Concept (c) Lowry Bronsted concept (d) None of these

(6) The conjugate base is a substance which is formed by donating a proton form

(a) Base (b) Acid (c) Both Acid and Base (d) All of these

(7) H_3O^+ is substance which is formed by accepting a proton by a base it is

(a) Base (b) Acid (c) Conjugate base (d) Congugate Acid

(8) Which of the following is amphoteric substance

(a) H_2O (b) Al_2O_3 (c) CO_2 (d) both A and B

(9) In a Chemical reaction

$$H_2SO_4 + H_2O \rightleftharpoons H_3O^+ + HSO_4^-$$

In above reaction which substance is lowry Bonsted acid

(a) H_2SO_4 (b) H_2O (c) HSO_4^- (d) None of these

Lewis Concept

(10) Lewis proposed an acid base theory in

(a) 1923 (b) 1887 (c) 1921 (d) 1911

(11) Which of following concept is more general and broader Acid Base Concept

(a) Arrhenius Concept

(b) Lewis Concept

(c) Lowry Bronsted Concept

(d) All of these

(12) According to Lewis concept Acid is a substance that

(a) Can accept proton

(b) Can donate electron pair

(c) Can accept electron pair

(d) Can donate proton.

(13) Which of the following is Lewis Base?

(a) H_2O (b) NH_3 (c) BF_3 (d) Both A and B

(14) Which of the following is Lewis acid

(a) H^+ (b) R-NH_2 (c) CH_3OH (d) NH_3

(15) $AlCl_3$ is _____acid

(a) Arhenius Acid

(b) Lewis Acid

(c) Lewry Bronsted Acid

(d) None of this

(16) The Lewis Acid base product is called

(a) Adduct (b) Product (c) Neutral Species (d) None of these

(17) The bond formed between lewis Acid and base is

(a) Covalent Bond (b) Ionic Bond (c) Hydrogen Bond (d) Co-ordinate Covalent Bond

(18) All anions are Lewis

(a) bases (b) Acids (c) Adduct (d) None of these

(19) In a Chemical reaction.

$$H^+ + OH^- \longrightarrow H_2O$$

In above expression which of the following substance is Lewis base

(a) H^+ (b) OH^- (c) H_2O (d) Both A and B

Self Ionization of Water

(20) The Value of ionic product of water at 25 °C is

(a) $1\times10^{-7}M$ (b) $1\times10^{-9}M$ (c) $1\times10^{-12}M$ (d) $1\times10^{-14}M$

(21) When the concentration of H^+ ions is greater then 10^{-7}, then a substance is
(a) Acid (b) Base (c) Neutral (d) None of these

Concept pH and pOH

(22) To express small concentration of H^+ and OH^- Icons by pH or pOH in more Convenient way by
(a) Soren Sorenson (b) Lewis (c) Lavoisier (d) Einstein

(23) When the concentration of OH^- ions is greater then 10^{-7}, then a substance is
(a) Acid (b) Base (c) Neutral (d) All of these

(24) The pH range at which Apple Plant grows is
(a) 6.5- 7.0 (b) 5.5-7.0 (c) 6-7 (d) 3-5

(25) The pH at which the plant of Broad Bean grows
(a) 6.5-7.0 (b) 5.5-7.0 (c) 5.2-6 (d) 6.5-7.5

(26) The Carrot plant grows Successfully at pH range.
(a) 6-7 (b) 4.5-5 (c) 3.2-6 (d) 6-7.5

(27) Onion Plant Successfully grow at pH range
(a) 6.5-7 (b) 6.5-7.5 (c) 6-7.0 (d) 4-5.5

(28) The pH range at which potatoes plant grows
(a) 5-6 (b) 6-7 (c) 5.5-6.5 (d) 6.5-7.5

(29) The Tomatoes plant successfully grow at the pH range.
(a) 5.5-7.0 (b) 6-5 (c) 5.6-7.0 (d) 6.5-7.5

pH Scale

(30) The pH of gastric juice is
(a) 1 (b) 2 (c) 4 (d) 5

(31) The pH of Lemon juice is
(a) 3 (b) 5 (c) 4 (d) 2

(32) The pH of Black Coffee is
(a) 4 (b) 5 (c) 3 (d) 6

(33) The pH of Distilled water is
(a) 6 (b) 7.5-8 (c) 7 (d) 8

(34) The pH of sea water is
(a) 7 (b) 8 (c) 6 (d) 4

(35) The pH of Baking soda is
(a) 8 (b) 10 (c) 7 (d) 9

(36) The pH of Milk of Magnesia is
(a) 10 (b) 9 (c) 11 (d) 12

(37) The pH of Soapy Solution is
(a) 10 (b) 12 (c) 11 (d) 13

(38) The pH of Bleach is

(a) 13 (b) 14 (c) 12 (d) 10

(39) The pH of Drain Cleaner is

(a) 12 (b) 13 (c) 14 (d) 09

(40) If the solution has hydrogen an concentration 1×10^{-3}M The solution is

(a) Acidic (b) Basic (c) Neutral (d) None of these

(41) Which of the following method is used to precise and accurate measurement of pH of a solution?

(a) Litmus paper (b) Universal indicator (c) Acid Base (d) PH Meter

(42) The pH at which the colour of methyl red change is

(a) 5 (b) 6 (c) 9 (d) 5.5

(43) Methyl red have ____ colour in strongly acidic medium

(a) Red (b) Yellow (c) Colorless (d) Pink

(44) The colour of Methyl red in strongly Basic Medium is

(a) Red (b) Yellow (c) Colorless (d) Pink

(45) The pH at which colour of Bromothymol blue changes is

(a) 9 (b) 5-5 (c) 7 (d) 8

(46) The Colour of Bromothnol blue in strongly basic medium is

(a) Yellow (b) Blue (c) Pink (d) Red

(47) The Colour of Bromothymol Blue in acidic medium is

(a) Yellow (b) Blue (c) Pink (d) Red

(48) The pH at which color of phenolphthalein Changes is

(a) 6 (b) 6-5 (c) 7 (d) 9

(49) The colour of phenolphthalein in strongly basic medium is

(a) Colorless (b) Pink (c) Red (d) Yellow

(50) The solution whose molarity is known is called

(a) Molar Solution (b) Standard Solution (c) Super Standard Solution (d) Standard Solution

Methods of Making salts

(51) The Cationic radical of a base and anionic radical of an acid combine together to form

(a) Salt (b) Base (c) Acid (d) None of these

(52) Which of the following is neutral salt

(a) NaCl (b) K_2SO_4 (c) $NaHSO_4$ (d) Both A and B

(53) Which of the following is Acidic salt

(a) $KHSO_4$ (b) NaCl (c) Pb(OH) Cl (d) K_2SO_4

(54) Which of the following is Basic salt

(a) K_2SO_4 (b) $NaHSO_4$ (c) Pb(OH)Cl (d) $NaNO_3$

(55) **The salts formed by H_3PO_4 are**
(a) NaH_2PO_4 (b) Na_2HPO_4 (c) Na_3PO_4 (d) All of these

(56) **Which of the following is example of an insoluble salt.**
(a) Na Cl (b) Cu SO_4 (c) AgCl (d) Ca Cl_2

Interesting Information

(57) **Which of the following metal is very toxic to fish and other aquatic life.**
(a) Al (b) Na (c) Mg (d) Ca

(58) **Smokers Breath a lot of _____ over a long period of time they have an increased risk of Suffering from cold, bronchitis and Asthma.**
(a) CO_2 (b) SO_2 (c) CO (d) None of these

(59) **An Analytical chemist measure the PH of solutions in order tc**
(a) Create soil conditions ideal for plant growth.
(b) Medical diagnoses.
(c) Maintaining the correct acid base balance in swimming pool.
(d) All of these:

(60) **Hydrochloric acid is used in**
(a) Fertilizers
(b) Cleaning of metals and bricks
(c) removing scales form boilers
(d) Both "B" and "C"

(61) **Which of the following Acid is used for manufacture of fertilizers and explosives.**
(a) H_2SO_4 (b) HNO_3 (c) HCl (d) Both A and B

(62) **Which of the following is used for the formation of soap.**
(a) NaOH (b) $Ca(OH)_2$ (c) LiOH (d) KOH

(63) **Which of the following is used in shaving cream**
(a) NaOH (b) KOH (c) Mg(OH) (d) All of these

(64) **The calcium hydroxide is used for the formation of**
(a) Mortar (b) Plasters (c) Cement (d) All of these

(65) **Which of the follwing is used to reduce the acidity of stomach.**
(a) $Ca(OH)_2$ (b) NaOH (c) $Mg(OH)_2$ (d) KOH

(66) **Fossil fuels contains small amount of**
(a) Nitrogen and Phosphorous
(b) Sulpher and phosphorous
(c) Nitrogen & Sulpher
(d) Oxygen and Carbon dioxide

(67) **The optimum pH range of swimming pool is**
(a) 7.2 - 7.6 (b) 6.5 - 7 (c) 7 - 8.5 (d) 6.5 - 7.5

(68) The amount of gastric juices Secreted by gastric glards every day is

(a)1 Liter (b) 3 Liter (c) 2.5 Liter (d) 2 Liter

(69) The Acid which is present in our stomach and used for digestion of food is

(a)H_2SO_4 (b) CH_3COOH (c) HCl (d) HNO_3

Other Relevant questions

(70) Which of the following can not classified as Arrhenius Acid.

(a)HNO_3 (b) H_2SO_3 (c) CO_2 (d) H_2SO_4

(71) NH_3 Cannot be classified as a base by

(a)Lewis theory

(b) Bronsted Lowry Theory

(c) Arrhenius Theory

(d) All of these Theory

(72) Choose Lewis acid

(a)CN^- (b) NH_3 (c) H_2O (d) H^+

(73) A drain solution contains 1×10^{-8}M OH^- Concentration this solution is

(a) Acidic (b) Basic (c) Neutral (d) Can not be predicted

(74) Milk of magnesia contains $Mg(OH)_2$. it is used as antacid it neutralizes excess stomach acid which salt is formed in this reaction

(a)$MgSO_4$ (b) $MgCO_3$ (c) $MgCl_2$ (d) Mg O

(75) In the following reaction which specie is donating an electron pair

$$NH_3 + BF_3 \longrightarrow H_3N-BF_3$$

(a)H (b) B (c) N (d) BF_3

(76) An aqueous Solution of NaOH is used as a drain Cleaner. If the concentration of hydroxide ion in this solution is 1×10^{-5}M, the concentration of H^+ in it would be

(a)1×10^{-5}M (b) 1×10^{-7}M (c) 1×10^{-9}M (d) 1×10^{-14}M

(77) Which of following has bitter taste

(a)Acid (b) Base (c) Salt (d) None of these

(78) When we put lemon juice on fish, the unpleasant fishy odour is due to

(a)Acid (b) alcohol (c) Amines (d) Citric Acid

ANSWER KEY

Q.	Ans.	Q.	Ans.	Q.	Ans.	Q.	Ans.	Q.	Ans.
1	a	17	d	33	c	49	b	65	c
2	c	18	a	34	b	50	b	66	c
3	b	19	b	35	d	51	a	67	a
4	b	20	d	36	a	52	d	68	d
5	c	21	a	37	b	53	d	69	c
6	b	22	a	38	a	54	c	70	a
7	d	23	b	39	c	55	c	71	c
8	d	24	b	40	a	56	c	72	a
9	a	25	a	41	d	57	a	73	b
10	a	26	d	42	d	58	b	74	c
11	b	27	b	43	a	59	d	75	c
12	c	28	c	44	b	60	d	76	c
13	d	29	a	45	c	61	b	77	b
14	a	30	a	46	b	62	a	78	c
15	b	31	d	47	a	63	b		
16	a	32	b	48	d	64	d		

TOPICAL SHORT QUESTIONS

Arrhenius concept

Q.1 What do you know about the arrhenius concept of Acid and Base?

Ans: Arrhenius put forward his concept in 1887

According to his theory

Acid: Acid is that substance which ionizes in water to produce H^+ ion.

$$NaOH \xrightleftharpoons{H_2O} Na^+ + OH^-$$

$$KOH \xrightleftharpoons{H_2O} K^+ + OH^-$$

$$HCl \rightleftharpoons H + Cl, \quad HNO_3 \rightleftharpoons H + NO_3$$

Base: Base is substance which ionizes in aqueous Solution to produce hydroxide ion.

e.g

$$NaOH \xrightleftharpoons{H_2O} Na^+ + OH^-$$

$$KOH \xrightleftharpoons{H_2O} K^+ + OH^-$$

Q.2 What are the limitation of Arrhenius Concept

Ans: Limitation of Arrhenius Concept:

This concept is applicable only in aqueous medium and does not explain nature of acid and base in non aqueous medium. According to these concept, acid and bases are only those substances which produces H^+ and OH^- respectively, it can't explain nature of CO_2 and Na_2O etc. which are acid and bases respectively

Bronsted –Lowry concept

Q.3 Define Acid and base Concept according to Lowry-Bronsted Theory?

Ans: In 1923 Lowry and Bronsted independently proposed acid base theory.

According to this Theory

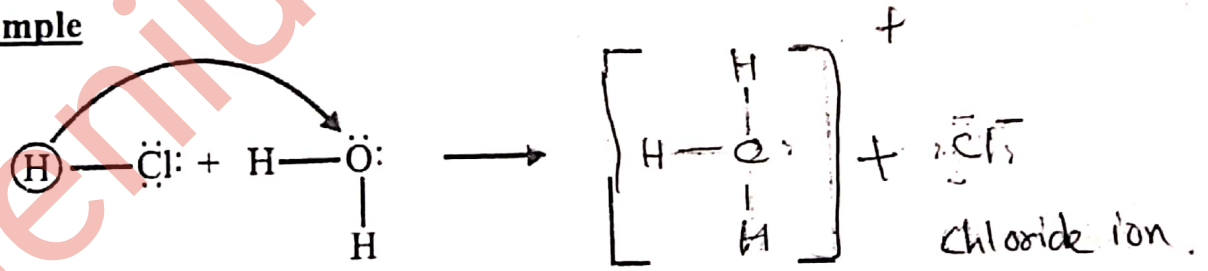
Acid:

The specie which donates are having ability to donate proton is called acid

Base:

The specie which excepts are having ability to accept the proton is called base

Example



Acid Base Hydronium ion

Q.4 Define Conjugate acid and conjugate Base? Give example.

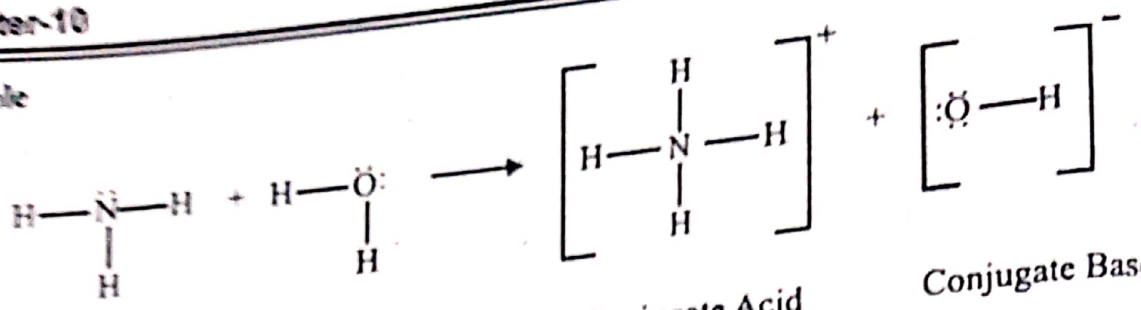
Ans: Conjugate Acid:

A Conjugate acid is a specie formed by accepting a proton by a Base.

Conjugate Base:

A Conjugate Base is specie formed by donating a proton by an acid.

Example



Base Acid Conjugate Acid Conjugate Base

Q.5 Why water is called Amphoteric Compound?

Ans: Amphoteric Compounds:
Those Compounds which can behave as acid and as well as base are called amphoteric compounds.
Water enhance as both as a acid and as well as base that's why water is called amphoteric compound as shown in example.

As a base:

$$HCl + H_2O \rightleftharpoons H_3O^+ + Cl^-$$

Acid Base

As an acid:

$$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$$

Base Acid

Q.6 Why all Bronsted bases are Lewis Bases but all Bronsted acids are not Lewis acid?

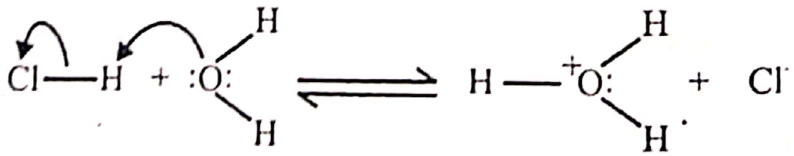
Ans: All Bronsted bases are Lewis Bases because according to bronsted concept base is a substance which can accept a proton, while according to Lewis concept, a base is a substance which can donate a pair of electron.
Lewis bases generally Contains one or more lone pair of electron and therefore they can't accept a proton. Thus all Bronsted bases are Lowry bases.
On the other hand Bronsted acid are those substances which can donate proton e-g HCl, HNO_3 and are not capable of accepting a pair of election. Hence all Bronsted acid are not Lewis acids.

Lewis Concept of acids and base

Q.7 What do you know about Lewis Concept of acids and Bases?

Ans: In 1923 Lewis put forward his Concept which more general Concept than Arrhenius and Lowry Bronsted Concept. Lewis Acid Base theory focuses a reaction.
Acid: A Lewis acid is substance that can accept a pair of electrons to form a coordinate covalent bond.
Base: A Lewis base is a substance that can donate a pair of electrons to form a coordinate covalent bond.

Example:



Electron Pair acceptor (Lewis acid) Electron Pair Donor (Lewis Base)

Self -ionization of water

Q.8 What is meant by auto-ionization of water?

Ans: The reaction in which two water molecules produce ins is called self ionization or auto-ionization of water.

In this reaction a water molecule that donates or loses a proton become a negatively charged hydroxide ion (OH^-). The other water molecule which gains are accepts the proton becomes positively charged hydronium ion (H_3O^+)

Q.9 What is the importance of Kw?

Ans: Kw is temperature dependent in any aqueous solution at 25°C, no matter what does it contains the product of H^+ ion concentration and OH^- ions Concentration is always equal to 1×10^{-14}. This means that if H^+ increase, the OH^-must decrease so that product of the two is still 1×10^{-14}.

When $[H^+] = [OH^-] = 1\times10^{-7}$ Solution is neutral

When $[H^+] > 1\times10^{-7}$ Solution is acidic

When $[H^+] < 1\times10^{-7}$ Solution is Basic

The pH scale

Q.10 What is meant by pH?

Ans: pH is defined as negative logarithm of the molar concentration of its coins in aqueous

$$pH = \log[H^+]$$

For pure water at 25°C

$$[H^+] = 1\times10^{-7} \quad [OH^-] = 1\times10^{-7}M$$

$$pH = -\log[H^+]$$

$$= -\log[1\times10^{-7}]$$

$$pH = 7$$

Thus pH of water is 7

Q.11 What is meant by pH Scale and it is used for what purpose?

Ans: Chemist use a number scale form 0 to 14 to describe the concentration of H^+ ions in a solution. This is known as pH Scale. pH scale is used to determine the acidic and basic nature of substance.

=> pH of 7 →indicates a neutral solution.

=> pH less than 7 → indicates acidic solution

=> pH greater than 7 → indicates basic solution

Q.12 What is meant by acidity of Stomach?

Ans: The main Component of gastric juice in the stomach is hydrochloric acid. Almost two litre of it is secreted each day by gastric glands. However some times too much acid is secreted in the stomach which causes indigestion. This is called acidity of stomach.

Q.13 What are indicators? Give examples?

Ans: The Indicators are the intensely coloured organic compounds they have different colour in acid and in alkaline solutions. They change colours with in small pH change and indicate the pH of solution by colour

$H_2CO_3 + 2NaOH \rightarrow Na_2CO_3 + H_2O$ Normal.

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Example

- Litmus paper:- it is red in acidic solution and blue in basic solution.
- Methyl orange:- It is red in strongly acidic medium and Yellow in Basic medium.
- Phenolphthalein: - It is colourless in strongly acidic medium and red in strongly alkaline medium. It changes its colour at pH 9.

Slats

- **Define salt and give examples.**

Ans: Salt:

The substance which is formed by the full or partial replacement of hydrogen of an acid with the metal ion or positively charged radical of a base is called salt.

e.g.

$$\underset{\text{Acid}}{HCl} + \underset{\text{Base}}{KOH} \longrightarrow \underset{\text{Salt}}{KCl} + H_2O$$

$$\underset{\text{Acid}}{H_2SO_4} + \underset{\text{Base}}{NaOH} \longrightarrow \underset{\text{Salt}}{NaHSO_4} + H_2O$$

Q.14 Define Normal or Neutral salt with examples?

Ans: Normal or Neutral Salt:

That salt which is farmed by completely replacement of ionisable H^+ of an acid by positive metal ion or NH_4^+ ions is called Normal or Neutral Salt.

Example

$$HCl + KOH \rightarrow KCl + H_2O$$
$$H_2SO_4 + ZnO \rightarrow Zn\,SO_4 + H_2O$$
$$HNO_3 + NH_4OH \rightarrow NH_4\,NO_3 + H_2O$$

Q.15 What are acidic salt and how they are converted into normal salt?

Ans: Acidic Salt:

That salt which is formed by partial replacement of replaceable H+ ions of an acid by positive metal in is called Acidic salt.

Example:

$$H_2\,SO_4 + KOH \rightarrow KH\,SO_4 + H_2O$$
$$H_3\,PO_4 + NaOH \rightarrow Na\,H_2\,PO_4 + H_2O$$

Conversion of acidic salt into normal salt:

When acidic salt react with bases they are converted into normal salt as show in given equations

$$KHSO_4 + KOH \rightarrow K_2\,SO_4 + H_2O$$
$$NaH_2PO4 + 2NaOH \rightarrow Na_3PO_4 + 2H_2O$$

Q.16 Define Basic Salt and how they are converted into Normal or neutral salt?

Ans: Basic Salt:

That Salt which are formed by the incomplete neutralization of a polyhydroxy base by an acid are called Basic salts.

Example

$$Zn(OH)_2 + HCl \rightarrow Zn(OH)Cl + H_2O$$
$$Pb(OH)_2 + CH_3COOH \rightarrow Pb(OH)CH_3COO + H_2O$$

Conversation of Basic salts into normal salt:

Basic Salt are converted into normal salty by reacting with acid

$$Zn(OH)Cl + HCl \rightarrow ZnCl_2 + H_2O$$
$$Pb(OH)CH_3COO + CH_3COOH \longrightarrow Pb(CH_3COO)_2 + H_2O$$

Interesting Formation

Q.17 What are the harmful effects of acid rain?

Ans: Acid rain can damage trees, kill huge areas of forest. It washes out aluminium ions from the soil. These aluminium ions run into rivers, lakes and ponds. Aluminium is very toxic to fish and other aquatic life. They can no longer survive in it and may be killed. Acid rain can also damage buildings and statues. The acid reacts with carbonates in lime stone. The lime stone dissolves and the statues. The acid reacts with carbonates in lime stone. The lime stone dissolves and the statue gradually crumbles away. Thus acid rain is an important environmental issue.

Q.18 What is present is smoke if cigarettes? Also discuss its effects on smokers

Ans: Sulphur dioxide and oxides of nitrogen are also produced by the smoking of cigarettes. Smoker breathe in a lot of sulphur dioxide. Over long period of time, they have an increased risk of suffering from cold, bronchitis and asthma.

Q.19 pH measurement plays which important role form analytical chemist?

Ans: Analytical chemist measures pH of solutions pH measurement has valuable application. For instance it helps analytical chemist to

(i) To create soil conditions ideal for plant growth
(ii) Medical diagnose
(iii) Maintaining the correct acid base balance in swimming pools
(iv) Electroplating
(v) Manufacture of medicine etc.

Q.20 Write uses of common acids

Ans:

Name	Formula	Common use
Hydrochloric acid	HCl	It is used in cleaning of metals, bricks and removing scale from boilers
Nitric acid	HNO_3	It is used in manufacture of fertilizers, explosives
Sulphuric acid	H_2SO_4	It is used in manufacture of many chemicals, drugs, dyes, paints and explosives.
Phosphoric acid	H_3PO_4	It is used in manufacture of fertilizers, acidulant for food

Q.21 Write the uses of common bases

Ans:

Name	Formula	Common use
Sodium hydroxide	NaOH	It is used in Soap making and drain cleaners
Potassium hydroxide	KOH	It is used in making liquid soap and shaving cream
Calcium hydroxide	$Ca(OH)_2$	It is used in making mortar, plasters, cement
Magnesium hydroxide	$Mg(OH)_2$	It is used as antacid, and laxative

Q.22 Why unpleasant fishy odour is produced. When we put lemon juice on fish? And how we reduce it

Ans: We make use of chemistry when we put lemon juice on fish. The unpleasant fishy odour is due to amines.

Reduction of odour:

The citric acid present in lemon juice converts amines to non-volatile salts, thus reducing the odour.

Q.23 What are the uses of salts?

Ans: Food preservation keeps food from spoiling and allows it to be stored for later use. Ancient methods for preserving include, drying fruits and vegetables, salting, boiling etc. Today, methods for preserving food also include the addition of preservatives. They are inhibitors of physical and chemical processes that causes food to spoil. Many foods are grown or produced in one location and then sent across the they reach their destinations. Many salts such as sulphites and benzoates are being used in food for thousands of years.

Q.24 What do you know about etching art?

Ans: Etching is an art that uses acid to crave patterns into metal, glass and other materials. For this a piece f metal or glass is covered with wax, and then a design is etched on to the plate through the wax. The plate is then dipped into a tank of acid. The acid eats away at the exposed portion, which leaves behind textured mark. The plate is then taken out of the acid and cleaned. Ink can also be applied on etching to create colourful design.

Q.25 Define neutralization & give examples.

Ans: Neutralization:

It is a type of reaction in which an acid reacts with the base and both cancel out the properties of each other. As a result of such type of reaction mostly salt and water is produced.

Neutralization is a specific term used for the reaction of acids and basis.

e.g.

(i) $HC\ell + NaOH \longrightarrow NaC\ell + H_2O$

Acid Base Salt water

(ii) $H_2SO_4 + MgO \longrightarrow MgSO_4 + H_2O$

Acid Base salt water

SELF ASSESSMENT EXERCISES

10.1 **Identify Bronsted acids and Bronsted bases in the following reactions.**

1. $H_2SO_4 + H_2S \rightleftharpoons HSO_4^- + H_3O^+$

   Acid Base Base Acid

2. $CH_3COOH + H_2O \rightleftharpoons CH_3COO + H_3O^+$

   Acid Base Base Acid

3. $H_2S + NH_3 \rightleftharpoons NH_4^+ + HS^-$

   Acid Base Acid Base

Ans:

1. $H_2SO_4 + H_2S \rightleftharpoons HSO_4^- + H_3O^+$

   Acid Base Base Acid

2. $CH_3COOH + H_2O \rightleftharpoons CH_3COO + H_3O^+$

   Acid Base Base Acid

3. $H_2S + NH_3 \rightleftharpoons NH_4^+ + HS^-$

   Acid Base Acid Base

In the above three reaction $H_2SO_4, H_3O+, CH_3COOH, H_2S$ and NA_4^+ are acids because these species donate or having ability to donate proton and $H_2O, HSO_4^-, CHCOO^-, NH_3$ and HS^- are bases because these species accepts or having ability to accepts the proton.

10.2 **Identify the Lewis acid and the lewis base in the following examples**

1. $Cl^- + AlCl_3 \longrightarrow [AlCl_4]^-$

   Base Acid Adduct

2. $H^+ + OH^- \longrightarrow H_2O$

   Acid Base

Ans:

$Cl^- + AlCl_3 \longrightarrow [AlCl_4]^-$

Base Acid Adduct

$H^+ + OH^- \longrightarrow H_2O$

Acid Base

In the above reaction $A\ell C\ell_3$ & H^+ are Lewis acid because they are electron deficient and $C\ell^-$ and OH are lewis base because they are electron pair donor.

10.3

1. **A soft drink has $[H^+] = 3\times10^{-3}$ M. is drink acidic neutral or basic**

Ans: Acidic because $3\times 10^{-3} > 1 \times 10^{-7}$

2. **Ordinary vinegar is approximately 1 M CH3COOH. Concentration of H+ in it is 4.2×10^{-3} M. is vinegar acidic, basic or neutral?**

Ans: Acidic because $9.2 \times 10^{-3} > 1\times 10^{-7}$

3. **A student determines the $[OH^-]$ of milk of magnesia, a suspension of solid magnesium hydroxide in its saturated solution and obtains a value of 4.2×10^{-3} M. is the solution acidic, basic or neutral**

Ans: Solution is basic because $[OH^-] = 4.2\times10^{-3}$

$$Kw = [H^+][OH]$$

$$Kw = 1\times10^{-14}$$

put the value of Kw and $[OH^-]$ in above equation

$$1\times10^{-14} = [H^+][4.2\times10^{-3}]$$

$$[H^+] = \frac{1\times10^{-14}}{4.2\times10^{-3}} = 0.2\times10^{-11}$$

because

$$0.2\times10^{-11} < 1\times10^{-7}$$

So solution is basic

10.4

1. **Write names of three acid – base indicators.**

Ans: (i) Methyl red (ii) Bromothymol blue (iii) Phenolphthalein

2. **What is the colour of methyl red in solution of (i) pH = 4 (ii) pH = 9?**

Ans: (i) In pH = 4 colour is red (ii) In pH = 9 colour is yellow

3. **Bromothymol blue added to a solution imparts blue colour.**

Ans: pH of solution is 9 because bromothymol blue imports blue colour is basic solution.

10.5

1 **Hydroxides such as $Mg(OH)_2$ called milk of magnesia is used as antacid. It neutralizes excess stomach acid (HCl). Write complete and balanced chemical equation for this neutralization reaction?**

Ans: $Mg(OH)_2 + 2HC\ell \longrightarrow MgC\ell_2 + 2H_2O$

2. **Hydrochloric acid (HCl) and potassium hydroxide (KOH) react and produce potassium chloride. Write complete and balanced chemical equation for this neutralization reactions?**

Ans: $HC\ell + KOH \longrightarrow KC\ell + H_2O$

3. **Balance following neutralization reactions**

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

$$H_3PO_{4(aq)} + NaOH_{(aq)} \longrightarrow Na_3PO_{4(aq)} + H_2O_{(l)}$$

Ans:

(i) $H_2SO_4 + 2NaOH \longrightarrow Na_2SO_4 + 2H_2O$

(ii) $H_3PO_4 + 3NaOH \longrightarrow Na_3PO_4 + 3H_2O$

10.6

Classify following salts as normal or acid salt.

$NaHSO_4$ Na_2SO_4 $KHCO_3$ K_2CO_3

Ans:

(a) $NaHSO_4$ = Acid slat

(b) Na_2SO_4 = Normal salt

(c) $KHCO_3$ = Acidic salt

(d) K_2CO_3 = Normal salt

LONG QUESTION

Q.1 What do you know about Arrhemius concept of a acid and bases? Explain with example?

Ans: Arrhenius Concept of Acids and Bases

In 1887, a Swedish chemist Svante Arrhenius proposed the first successful theory of acids and bases.

According to this theory

Acid:

An acid is a substance that ionizes in water to produce H^+ ions.

$$HCl_{(g)} \xrightleftharpoons{H_2O} H^+_{(aq)} + Cl^-_{(aq)}$$

Base:

A base is a substance that ionizes in water to produces OH^- ions

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

In the following examples NHO_3 and H_2SO_4 are acids becomes they produce H^+ ions in H_2O

$$HNO_{3(l)} \xrightleftharpoons{H_2O} H^+_{(aq)} + NO^{-1}_3$$

$$H_2SO_{4(l)} \xrightleftharpoons{H_2O} 2H+_{(aq)} + SO^{-2}_{4\,(ag)}$$

KOH and NH_4OH are Arrhrus lages because they produce OH^- ion in H_2O

$$KOH(s) \xrightleftharpoons{H_2O} K+_{(aq)} + OH^-_{(aq)}$$

$$NH_4OH(l) \xrightleftharpoons{H_2O} NH^+_{4\,(aq)} + OH^-_{(aq)}$$

Limitation:

(i) It applies only in a aqueous solution it does not explain acidic or basic nature of substance in non-aqueous medium

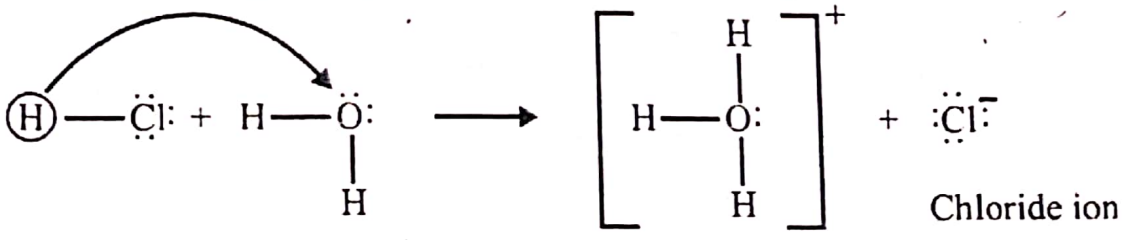
(ii) It does not explain the compounds CO_2, SO_2 etc. are acids because they do not produce hydrogen ion but they are acidic in nature.

Q.2 Write a detail note on bronsted concept of acid and bas limitation

Ans: Bronsted–Lowry concept of acids and bases:

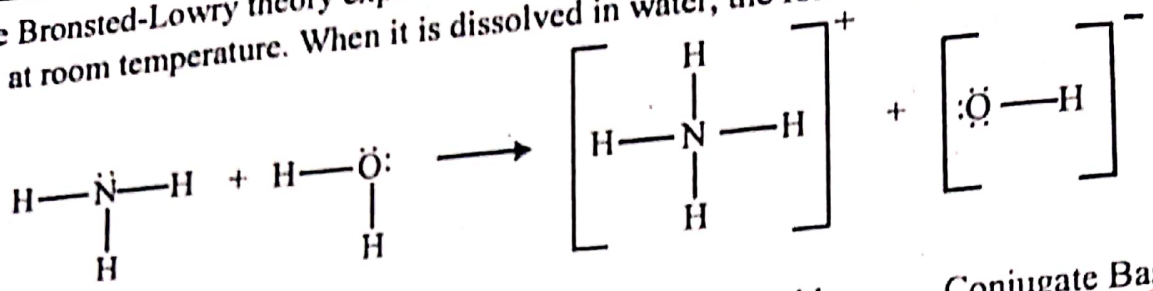
In 1923 J.N Bronsted and T.M Lowery independently proposed another theory to overcome the shortcomings of arrhenius theory. This theory is known as Bronsted-Lowery theory.

According to this theory an acid is a proton donor and a base is a proton acceptor consider the following example



Acid Base Hydronium ion

The Bronsted-Lowry theory explains how ammonia acts as a base in water. Ammonia is a gas at room temperature. When it is dissolved in water, the following reaction occurs.



Base Acid Conjugate Acid Conjugate Base

Which substance is proton donor, NH_3 or H_2O? Which substance is proton acceptor? All the acids included in the Arrhenius theory are also acids in the Bronsted- Lowery Theory. However all the bases included in Bronsted-Lowery theory except OH^- are not Arrhenius bases. Consider above two examples. In one example, water molecule accepts a proton and in the other water donates a proton. This means water behaves like an acid as well as a base. It is amphoteric in nature. Substances that react with both acids and bases are called amphoteric

Q.3 Explain Lewis concept in detail with examples

Ans: Lewis Concept of Acids and Bases

In 1923, G.N Lewis proposed an acid base theory that focuses on reaction. This concept is more general than either the Arrhenius theory or the Bronste-Lowery theory.

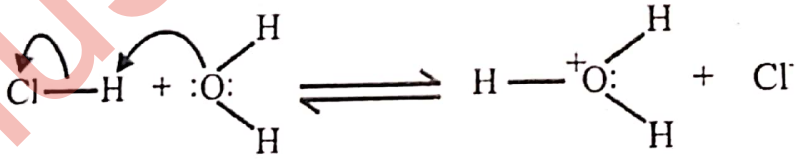
Acid:

A Lewis acid is substance that can accept a pair of electrons to form a coordinate covalent bond.

Base:

A Lewis base is a substance that can donate a pair of electrons to form a coordinate covalent bond.

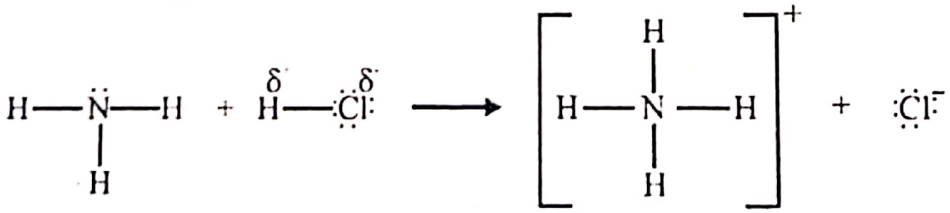
In a Lewis acid-base reaction a coordinate covalent bond is formed between the acid and the base.



Electron Pair acceptor . (Lewis acid)

Electron Pair Donor (Lewis Base)

Consider the following reactions.



Nitrogen atom in ammonia donates an electron pair to H-atom in HCl. Which species in Lewis acid? HCl or NH_3

HCl is the Lewis acid and NH_3 is Lewis base.

The Lewis structure demands that the central atom or atom of Lewis acid has a deficiency of an electron pair and can accommodate an unshared electron pair. On the other hand, the central atom of a Lewis base has complete octet possessing one or more unshared electron pairs. Hence base has an ability to donate an unshared electron pair.

Certain substances li8ke SO_2, CO_2, CaO, BF_3 etc. behave as acids or bases although they do not have ability to donate or accept protons. Nature of such substances cannot be explained by Arrhenius theory or the Bronsted-Lowry theory

Q.4 Why water show natural behaviour? Explain with the help of pH.

Ans: Self-ionization of water – The pH scale

Water molecules are highly polar. Occasionally, the collisions between water molecules are energetic enough to transfer a proton from one water molecule to another.

A water molecule that donates or loses a proton becomes a negatively charged hydroxide ion OH^-. The other water molecule which gains or accepts the proton

This reaction can be written as

$$2H_2O \rightleftharpoons H_3O^+ + OH^-$$

The reaction in which two water molecules produce ions is called as the self-ionization or auto-ionization of water. This reaction can also be written as a simple ionization of water.

$$H_2O_{(l)} \rightleftharpoons \underset{\text{Hydrogen ion}}{H^+_{(aq)}} + \underset{\text{Hydroxide ion}}{OH^-_{(aq)}}$$

Water is a weak electrolyte. The self-ionization of water occurs to a very small extent. At 25°C the experimentally detemined concentrations of H^+ ions and OH^- ions are as follows.

$$[H+] = [OH] = 1\times10^{-7}M$$

You can write equilibrium constant expression for the self-ionization of water as follows.

$$Kc = \frac{[H^+][OH]}{[H_2O]}$$

Since H2O is a weak electrolyte, so the concentration of $[H_2O]$ will remain constant.

$$K_c[H_2O] = [H^+][OH^-]$$

$$K_w = [H^+][OH^-]$$

Where $K_w = K_c\,[H_2O]$ is called ionization constant for water. It is also called the ion-product for water. For water.

$$K_w = (1\times10^{-7})(1\times10^{-7}) = 1\times10^{-14} \text{ at } 250°C$$

In pure water, the concentrations of H^+ and OH^- ions are equal.

$$[H^+]=[OH^-]=1\times10^{-7} \text{ at } 25°C$$

In 1 909, the Danish biochemist Soren Sorenson proposed a convenient method to express such a small concentration of H^+ ions and OH^- ions by pH or pOH

pH is defined as the negative logarithm of the molar concentration of H^+ ions in aqueous solutions.

$$pH = -\log[H^+]$$

For pure water at 25°C

$$[H^+] = 1 \times 10^{-7}\ M,\ [OH] = 1 \times 10^{-7}\ M$$

$$pH = -\log (1 \times 10^{-7}) = 7$$

Thus pH or water is 7. All aqueous solutions with pH = 7 at 25°C are neutral. If pH is less than 7, the solutions become acidic. $[H^+]$ increases and [OH] decreases.

Q.5 How we can prepare salts?

Ans: General Methods for the preparation of salts

There are five general methods for the preparation of salts. Four methods make soluble salts but one prepares insoluble salts.

(i) Preparation of soluble salts

Soluble salts are often prepared in water. Therefore, they are recovered by

- Evaporation
- Crystallization

(a) By the reaction of an acid and a metal (Direct displacement method)

This is direct displacement method in which hydrogen ion of acid is replaced by reactive metal. Such as calcium, Zinc and iron

e.g.

$$\text{Acid} + \text{Metal} \longrightarrow \text{Salt} + H_2$$

$$2HCl + Mg \longrightarrow MgCl_2 + H_2$$

(b) By reaction of acid and base (Neutralization method)

It is a neutralization reaction in which acid and base react to produce a salt and water.

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

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

(c) By reaction of acid and metallic oxide

Mostly the insoluble metallic oxides react with dilute acids to form salt and water.

$$\text{Acid} + \text{Metalic oxide} \longrightarrow \text{Salt} + \text{Water}$$

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

(d) By reaction of acid and carbonate

Dilute acids react with metallic carbonates to produce salts, water and carbon dioxide gas.

$$2NHO_3 + Na_2O_3 \longrightarrow NaNO_3 + H_2O + CO_2$$

(ii) Preparation of insoluble salts

In this method, usually solutions of soluble salt are mixed. During the reaction exchange of ionic radicals (i.e. metallic radicals exchange with acidic radicals) takes place to produce new salts. One of the salts is insoluble and the other is soluble. The insoluble salt precipitates out (solidity in solution)

$$AgNO_{3(aq)} + NaCl_{(aq)} \longrightarrow \underset{\text{insoluble}}{AgCl_{(s)}} + NaNO_{3(aq)}$$

$$Na_2CO_{3(aq)} + CuSO_{4(aq)} \longrightarrow \underset{\text{insoluble}}{CuCO_{3(s)}} + Na_2SO_{4(aq)}$$

REVIEW QUESTIONS FROM TEXT BOOK

Q.1: Encircle the correct answer

(1) Which of the following cannot be classified as Arrhenius acid?

(a) HNO_3 (b) H_2CO_3 (c) CO_2 (d) H_2SO_4

(2) NH_3 cannot be classified as a base by

(a) Lewis theory (b) Bronsted –Lowry theory

(c) Arrhenius theory (d) All of theses theories

(3) Which of the following is a Lewis base?

(a) BF_3 (b) HCl (c) $AlCl_3$ (d) F^-

(4) Choose Lewis acid

(a) CN^- (b) $\ddot{N}H3$ (c) $H2\ddot{O}:$ (d) H^+

(5) A drain cleaner solution contains 1.0×10^{-8} M, OH^- concentration. This solution is

(a) Acidic (b) Basic (c) Neutral (d) Cannot be predicted

(6) Milk of magnesia contains $Mg(OH)_2$. It is used an antacid. It neutralizes excess stomach acid. Which salt is formed in this reaction?

(a) $MgSO_4$ (b) $MgCO_3$ (c) $MgCl_2$ (d) MgO

(7) Ammonia is a base, because it

(a) Ionizes in water to give OH^- ions (b) Contains OH group

(c) Can accept an election pair (d) Can accept proton

(8) Consider the following reaction?

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

(a) H_2O (b) HCl (c) H3O+ (d) None of these

(9) In the following reaction which species is donating an electron pair.

$$NH_3 + BF_3 \longrightarrow H_3N\text{-}BF_3$$

(a) H (b) B (c) N (d) BF_3

(10) An aqueous solution of NaOH is used as drain cleaner. If the concentration of OH ions in this solution is 1.0×10^{-5} M, the concentration of H^+ ions in it would be?

(a) 1.0×10^{-5} M (b) 1.0×10^{-7} M (c) 1.0×10^{-9} M (d) 1.0×10^{-14} M

ANSWER KEY

Q.	Ans.	Q.	Ans.	Q.	Ans.	Q.	Ans
1	c	4	d	7	d	10	c
2	c	5	a	8	b		
3	d	6	c	9	c		

SHORT QUESTIONS

Q.2 Write short answers of the following

(i) Write the equation for self ionization of water.

Ans: self ionization

The reaction in which two water molecules produce ions is called as the self ionization o auto ionization of water. This reaction can also be written as a simple ionization of water.

$$H^2O_{(\ell)} \rightleftharpoons H^+_{(aq)} + OH^-_{(aq)}$$

A water molecule that donates or cases a proton becomes a negatively charged hydroxide ion OH^-. The other water molecule which gains or accepts proton becomes positively charged hydronium ion. This reaction can be written as

(ii) Define and give examples of arrhenius acids.

Arrehenius acids:

An acid is a substance that ionizes in water to produce H^+ ions.

Examples:

$$HCl_{(g)} \xrightleftharpoons{H_2O} H^+_{(aq)} + Cl^-_{(aq)}$$

$$HNO_{3(l)} \xrightleftharpoons{H_2O} H^+_{(g)} + NO^{-1}_{3\ (g)}$$

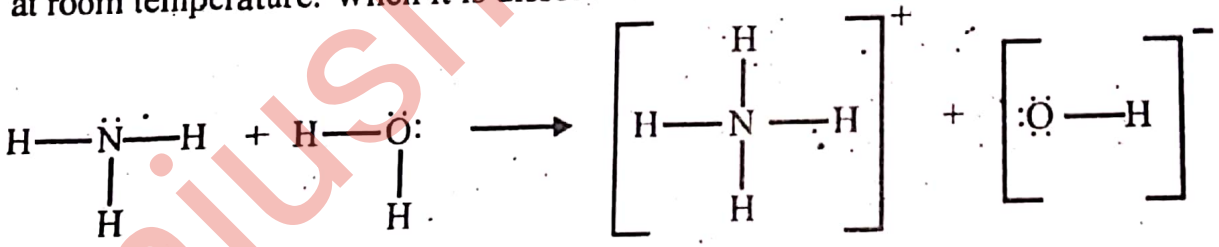
(iii) Why H^+ ion acts as a lewis acid?

Ans: A Lewis acid is alone pair acceptor, the H^+ ion has no electrons, so can easily accept a lone pair from another atom. That is why H^+ ion acts as a lewis acid.

(iv) Why NH_3 acts as Bronsted-lowry base?

Ans: Ammonia as a base

Bronsted-Lowry theory explains how ammonia acts as a base in water. Ammonia is a gas at room temperature. When it is dissolved in water the following reaction occurs.



Base Acid Conjugate Acid Conjugate Base

Water is proton donor and ammonia proton acceptor. Therefore water acts as an acid and ammonia acts as a base.

(v) Why BF_3 acts as lewis acid?

Ans: BF_3 as lewis acid

Boron in BF_3 has incomplete octet. It has six electrons (3 electron pairs). So it needs an electron pair to complete its octet. Hence BF_3 is an electron pair acceptor or lewis acid.

Ammonium hydroxide and nitric acid react and produce ammonium nitrate and water. Balanced chemical equation for this neutralization reaction is,

$$BF_3 + NH_3 \longrightarrow [F_3B \leftarrow :NH_3]$$

(vi) **Write balanced chemical equations for the following neutralization reactions.**

Sulphuric acid + magnesium oxide → magnesium sulphate + water

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

Sulphuric acid + sodium hydroxide → sodium sulphate + water

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

Hydrochloric acid + calcium hydroxide → calcium chloride + water

$$2HC\ell + Ca(OH)_2 \longrightarrow CaC\ell_2 + 2H_2O$$

(vii) **Identify Bronsted-Lowry acids or bases in the following reactions.**

$$HNO_3 + H_2O \longrightarrow H_3O^+ + NO_3^-$$

$$NH_3 + HNO_3 \longrightarrow NH_4NO_3$$

Ans: Since HNO_3 is converted to NO_3^- by do noting proton therefore HNO3 is an acid. Since NH_3 accepts the proton and forms NH_4^+ so it is a base.

(viii) **Identify lewis acid and base in given reactions.**

$$F^- + BF_3 \longrightarrow \left[BF_4\right]^-$$

$$H^+ + NH_3 \longrightarrow \left[NH_4\right]^+$$

$$NH_3 + AlCl_3 \longrightarrow \left[H_3N + AlCl_3\right]$$

Ans:

(i) F^- has a lone pair on F atom. So it is electron pair donor. F^- is a lewis base Boron has incomplete octet so it accepts electron pair and acts as Lewis acid.

(ii) A Lewis acid is a lone pair acceptor, the H+ ion has no electrons, so can easily accept a lone pair form another atom. That is why H^+ ion acts as a Lewis acid. NH_3 has a lone pair on N-atom. So it is electron pair donor. NH^3 is a lewis base.

(iii) In $AlCl_3$ aluminium is deficient of two electrons. Therefore it will be called Lewis acid. NH_3 contains a lone pair and can be donated to $AlCl_3$. Hence NH_3 will act as lewis base

Q.7 Classify the following solutions as acidic, basic or neutral.

(i) A solution that has hydrogen ion concentration 10×10^{-3} M.

Ans: $\left[H^+\right] = 1.0\times10^{-3}\,M > 1.0\times10^{-7}\,M,$

the solution is acidic.

(ii) A solution that has hydrogen ion concentration 10×10^{-10}M.

Ans: $\left[H^+\right] = 1.0\times10^{-10}\,M < 1.0\times10^{-7},$

The solution is basic

(iii) A solution that has hydroxyl ion concentration 10×10^{-10}M.

Ans:

$$[OH^-] = 1.0 \times 10^{-3} M$$

$$[H^+] = ?$$

$$Kw = [H^+][OH^-]$$

$$1.0 \times 10^{-14} = [H^+][1.0 \times 10^{-3}]$$

$$[H^+] = 1.0 \times 10^{-11} M$$

Because $1.0 \times 10^{-11} M < 1.0 \times 10^{-7} M$ the solution is basic.

(iv) A solution that has hydroxyl ion concentration 1.0×10^{-10}M.

Ans:

$$[OH^-] = 1.0 \times 10^{-10} M$$

$$[H^+] = ?$$

$$Kw = [H^+][OH^-]$$

$$1.0 \times 10^{-14} = [H^+][1.0 \times 10^{-10}]$$

$$[H^+] = 1.0 \times 10^{-3} M$$

Because $1.0 \times 10^{-3} M > 1.0 \times 10^{-7} M$ the solution is acidic.

Q.8 *Classify following substance as Lewis acid and bases.*

$$NH_3, F^-, H_2\ddot{O}:, BF_3$$

Ans:

NH_3 = Base

F^- = Base

$H_2\ddot{O}:$ = Base

BF_3 = Acid

Q.9 Give the Bronsted-Lowry definition of an acid. Write an equation that illustrates the definition.

Ans: See definition and example in long question answers

Q.10 Give Bronsted-lowry definition of a base. Write an equation that illusrates the definition.

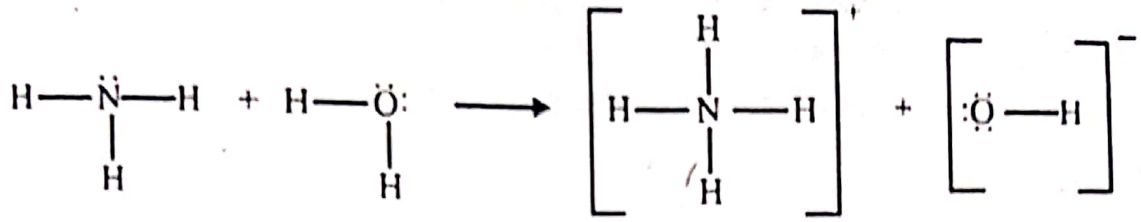
Ans: Bronsted lowry base:

According to Bronsted-lowry concept

Base is a substance which accepts the proton

Example:

Bronsted lowry theory explain how NH_3 acts as a base in water. NH_3 is a gas at room temperature. When it is dissolved in water, the following reaction occurs.



Base Acid Conjugate Acid Conjugate Base

Water is proton donor and ammonia proton acceptor. Therefore water acts as an acid and ammonia as base.

Q.11 Identify Bronsted acids and Bronsted bases in the following reaction

(i) $CH_3COOH_{(aq)} + H_2O \rightleftharpoons CH_3COO^-$

Ans: CH_3COOH is acid and H_2O is base

(ii) $HCO^-_{3(aq)} + H_2O_{(l)} \rightleftharpoons CO^{-2}_{3\,(aq)} + H_3O^+_{(aq)}$

Ans: HCO_3^- is an acid and H_2O is base

(iii) $NH_{3(g)} + H_2O_{(l)} \rightleftharpoons NH^+_{4(aq)} + OH^-_{(aq)}$

Ans: H_2O is acid and NH_3 is base

(iv) $HCl_{(aq)} + HCO^-_{3(aq)} \rightleftharpoons H_2CO_{3(aq)} + Cl^-_{(aq)}$

Ans: HCl is acid and HCO_3^- is base

(v) $HS^-_{(aq)} + H_2O_{(l)} \rightleftharpoons S^{-2}_{(aq)} + H_3O^+_{(aq)}$

Ans: HS^- is acid and H_2O is base

(vi) $H_2S + NH_3 \rightleftharpoons NH_4^+ + HS^-$

Ans: H_2S is acid and NH_3 is base

Q.12 Identify the Lewis acids and the Lewis bases in the following reactions.

(i) $Ag^+_{(aq)} + CN^-_{(aq)} \longrightarrow Ag(CN)_{(aq)}$

Ans: Ag^+ is Lewis acid and CN^- is Lewis base

(ii) $B(OH)_{3(s)} + OH^-_{(aq)} \longrightarrow B(OH)^-_{4(aq)}$

Ans: $B(OH_3)$ Lewis acid and OH^- is Lewis base

(iii) $Cu^{+2}_{(aq)} + 4NH_{3(aq)} \longrightarrow \left[Cu(NH_3)_4\right]^{+2}_{(aq)}$

Ans: Cu^{+2} lewis acid and NH_3 is lewis base

(iv) $OH^-_{(aq)} + Al(OH)_{3(s)} \longrightarrow Al(OH)^-_{4(aq)}$

Ans: $Al(OH)_3$ lewis acid and OH^- is lewis base

Q.13 Identify lewis acids and lewis bases from the following.

$AlCl_3$, Ag^+, $CH_3-\ddot{O}H$, $CH_3-\ddot{N}H_2$, CN^-, OH^-, $FeCl_3$

Ans: Lewis Acids = $A\ell C\ell_3, Ag^+, FeC\ell_3$

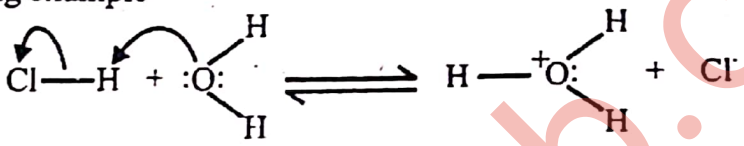
Lewis bases $CH_3OH, CH_3-NH_2, CN^-, OH^-$

Q.14 Classify water as proton donor or proton acceptor.

Ans: Water molecule accepts a proton and in the other water donates a proton. This means water behaves as acid as well as base. H_2O is amphoteric in nature. Substance, that react with both acids and bases to neutralize them are called amphoteric substances.

Example:

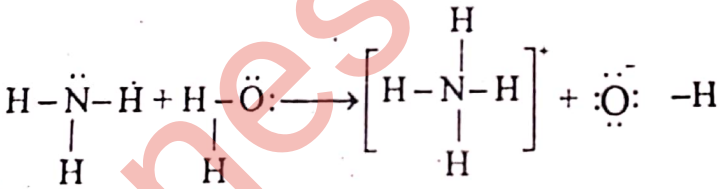
Consider following example



Electron Pair acceptor (Lewis acid)	Electron Pair Donor (Lewis Base)

Water is proton acceptor and HCl is proton donor. There for water acts as a base and HCl is an acid.

Consider another example



Water is a proton donor and ammonia proton acceptor. Therefore water acts as an acid and water as a base.

Q.15 Write equations showing the ionizaiton of the following as arrhenius acids.

(a) $HI_{(aq)}$ (b) $HNO_{2(aq)}$

Ans: (a) $HI_{(aq)}$

$$HI_{(aq)} \xrightleftharpoons{H_2O} H^+ + Cl^-$$

(b) $HNO_{2(aq)}$

$$HNO_{2(aq)} \xrightleftharpoons{H_2O} H^+ + NO_2^-$$

Q.16 Write equations showing the ionization of the following as Brondsted –Lowry acids

(a) $NHO_{2(aq)}$ (b) $HCN_{(aq)}$

Ans: (a) $HNO_{2(aq)}$

$$HNO_2 + H_2O \longrightarrow H_3O^+ + NO_2^-$$

(b) $HCN_{(aq)}$

$$HCN + H_2O \longrightarrow H_3O^+ + CN^-$$

THINK-TANK

Q.17 What is true about the relative concentrations of hydrogen ions and hydroxide ions in each kind of solution. (a) acidic (b) basic (c) neutral

Ans: **(a)** Acidic $[OH^-] < [H^+]$

(b) Basic $[OH^-] > [H^+]$

(c) Neutral $[OH^-] = [H^+]$

Q.18 Codeine, $C_{18}H_{21}NO_3$ is a commonly prescribed pain killer. It dissolves in water by the following reaction?

$$C_{18}H_{21}NO_3 + H_2O \longrightarrow [C_{18}H_{21}HNO_2]^+ OH^-$$

Identity codeine as Bronsted lowry acid or base.

Ans: Codeine is Lewis acid since it is able to accept electrons.

Q.19 Suggest some ways in which you might determine whether a particular water solution contains an acid or base.

Ans: Litmus paper is one way. An indicator solution, Like phenolphthalein, would also work. pH meter can also used for determining acidic or basic nature of solution. These machines called pH meter used to measure pH. If pH is lower than 7 it is acidic and if higher than 7 then it is basic.

Q. 20 The table below shows the colours of two indicators in acidic and alkaline solution

Indicator	Colour in Acidic solution	Colour in Alkaline solution
A	Red	Blue
B	Colourless	Red

(a) What will be the colour of the indicator A?

(i) In A solution of pH 3

Ans: In a solution of pH 3 = red colour

(ii) In A solution of pH 10

Ans: In A solution of pH 10= Blue colour

(b) What will be the colour of the indicator B in a solution of pH 5?

Ans: The colour of the indicator B in a solution of pH 5 is colourless because the solution is acidic

(c) When a few drops of indicator B are placed in a solution X, it turns red immediately. What can you deduce about the properties of solution X?

Ans: When a few drops of indicator B are placed in a solution x, it turns red immediately. This turning of colour of indicator B into red represent that solution in alkaline.

Q.21 Bacteria in our mouth feed on small particles of food stuck to our teeth and change it into acid. Explain how using toothpaste of pH 10 can help to prevent acid form damaging our teeth.

Ans: Toothpaste of pH 10 mildly alkaline. The alkaline pH of tooth paste helps neutralize the plague acids which cause tooth decay.