Descriptive Questions

Q.I. (Ex. Q.4 (i)) Explain Arrhenius concept of acids and bases.

Ans. Arrhenius Concept of Acids and Bases: Svante Arrhenius, 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 a substance that dissociates in water to give protons (H^+) or hydronium ions (H_3O^+). Some typical Arrhenius acids are HCl, HNO_3, H_2SO_4, and HCN.

Example:

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

$HNO_3 \rightarrow H^+ + NO_3^-$

Arrhenius Base: A base is a substance that dissociates in water to give hydroxyl ions (OH^-). Some typical Arrhenius bases are NaOH, KOH, and $Ba(OH)_2$. **taleemzone.com**

Example:

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

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

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

$H^+ + H_2O \rightarrow H_3O^+$ **taleemzone.com**

Q.2. (Ex. Q.4 (ii)) Compare Arrhenius and Bronsted-Lowry concepts of acids and bases.

Feature	Arrhenius Concept	Bronsted-Lowry Concept
Definition of Acid	A substance that produces H^+ (or H_3O^+) ions in water.	A substance (molecule or ion) that can donate a proton (H^+).
Definition of Base	A substance that produces OH^- ions in water.	A substance (molecule or ion) that can accept a proton (H^+).
Solvent	Limited to aqueous solutions (water is the only solvent).	Not limited to water; applicable to any solvent or even the gas phase.
Example of Acid	HCl, HNO_3 (must have ionizable H).	HCl, NH_4^+, HSO_4^- (any proton donor).
Example of Base	NaOH, KOH (must have OH^- group).	NH_3, CO_3^{2-}, Cl^- (any proton acceptor).
Limitation	Cannot explain the basic nature of substances like NH_3 or Na_2CO_3.	More general and widely applicable.

Q.3. (Ex. Q.4 (iii)) How does sulphuric acid react with the following compounds? NH_4Cl, NH_4NO_3, MgO, $MgCO_3$

Ans.

(i) With Ammonium Chloride (NH_4Cl):

When sulphuric acid reacts with ammonium chloride, it produces ammonium sulphate ($(NH_4)_2SO_4$) and hydrochloric acid (HCl).

Equation: $H_2SO_4 + 2NH_4Cl \rightarrow (NH_4)_2SO_4 + 2HCl$

(ii) With Ammonium Nitrate (NH_4NO_3):

The reaction of sulphuric acid with ammonium nitrate results in the formation of ammonium sulphate and nitric acid (HNO_3).

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

(iii) With Magnesium Oxide (MgO):

Sulphuric acid reacts with magnesium oxide to produce magnesium sulphate ($MgSO_4$) and water (H_2O).

Equation: $H_2SO_4 + MgO \rightarrow MgSO_4 + H_2O$

(iv) With Magnesium Carbonate ($MgCO_3$):

When magnesium carbonate reacts with sulphuric acid, it produces magnesium sulphate, carbon dioxide (CO_2), and water.

Equation: $H_2SO_4 + MgCO_3 \rightarrow MgSO_4 + CO_2 + H_2O$

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

Ans. Nature of Reaction:

When a base reacts with a non-metallic oxide, a salt and water are typically formed. This reaction is a type of neutralization reaction. Non-metallic oxides, such as carbon dioxide (CO_2) or sulphur dioxide (SO_2), are generally acidic in nature.

Example:

For example, when sodium hydroxide (a base) reacts with carbon dioxide (a non-metallic oxide), the following reaction occurs:

Equation: $2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$

In this case, sodium carbonate (Na_2CO_3) is formed along with water.

We can infer that non-metallic oxides tend to exhibit acidic properties when they react with bases. This characteristic is due to their ability to react with bases to produce salts and water, indicating that they can act as acids in a chemical reaction. Thus, non-metallic oxides are often classified as **acidic oxides**.

Q.5. (Ex. Q.4 (v)) State the reason for showing acidic character by both dry HCl gas and HCl solution in water.

Ans. The acidic character of both dry hydrogen chloride (HCl) gas and HCl solution in water can be explained by their ability to donate protons (H^+) in a chemical reaction.

(i) Dry HCl Gas: Even in its gaseous form, HCl can act as an acid. When it comes into contact with moisture or water vapor in the environment, it can dissociate to release H^+ ions. Although dry HCl gas is not an acid in the traditional sense, it can still exhibit acidic properties when it interacts with a suitable substance (like a base). **taleemzone.com**

(ii) HCl Solution in Water: When HCl is dissolved in water, it completely dissociates into H^+ ions and Cl^- ions. The presence of H^+ ions in the solution gives the solution its acidic character. The more H^+ ions present, the stronger the acidity of the solution.

Q.6. (Ex. Q.4 (vi)) Differentiate between an acid and its conjugate base.

Ans. An acid and its conjugate base are related but represent different forms of a chemical species in a proton transfer reaction.

Definitions:

- An **acid** is a substance that can donate a proton (H^+) to another substance.
- A **conjugate base** is the species that is formed after an acid donates a proton.

Example:

When hydrochloric acid (HCl) donates a proton, it becomes its conjugate base, which is the chloride ion (Cl^-). The reaction can be represented as follows:

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

(Acid) (Base) (Conjugate Acid) (Conjugate Base)

Strength: Acids can vary in strength, with strong acids completely dissociating in water, while weak acids partially dissociate. The conjugate base of a strong acid is typically weak and does not readily accept protons, while the conjugate base of a weak acid is stronger and can accept protons more easily.

Role in Reactions: Acids are proton donors, while conjugate bases act as proton acceptors in acid-base reactions. This relationship is essential in understanding the concept of acid-base equilibria.

Investigative Questions

Q.1. (Ex. Q.5 (i)) Acids play significant roles within the human body. Comment on this statement.

Ans. Acids play significant roles within the human body. The following are some of the importance of acids in various physiological processes:

(i) Digestion: One of the most well-known acids in the human body is hydrochloric acid (HCl), which is secreted by the stomach lining. It creates an acidic environment that helps break down food, activates digestive enzymes, and kills harmful bacteria that may enter with food.

(ii) pH Balance: Acids are crucial for maintaining the body's pH balance. The human body operates optimally at a specific pH range, and various acids help regulate this balance. For example, carbonic acid plays a key role in maintaining blood pH.

(iii) Metabolism: Many metabolic processes involve acids. For instance, lactic acid is produced during anaerobic respiration when glucose is broken down for energy in the absence of oxygen. This process is essential during intense exercise when the body requires quick energy.

(iv) Cellular Functions: Acids are involved in various cellular functions, including the synthesis of DNA and RNA. Nucleic acids, which are essential for genetic information, contain acidic components.

(v) Electrolyte Balance: Acids contribute to the balance of electrolytes in the body, which is vital for nerve function and muscle contraction. For example, the dissociation of acids in solution can release ions that help conduct electrical signals.

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Q.2. (Ex. Q.5 (ii)) What is observed when CO_2 is passed through lime water (i) for a short duration (ii) for long duration?

Ans. When carbon dioxide (CO_2) is passed through lime water, which is a dilute solution of calcium hydroxide ($Ca(OH)_2$), different reactions occur depending on the duration of exposure.

1. For a Short Duration: When CO_2 is bubbled through lime water for a short time, a reaction occurs where carbon dioxide reacts with calcium hydroxide to form calcium carbonate ($CaCO_3$), which is a white precipitate. The solution will turn milky due to the formation of this precipitate.
Equation: $Ca(OH)_2$ (aq) + CO_2 (g) → $CaCO_3$ (s) + H_2O (l)
2. For a Long Duration: If CO_2 is passed through lime water for an extended period, the initial precipitate of calcium carbonate will eventually dissolve in excess CO_2, forming calcium bicarbonate ($Ca(HCO_3)_2$), which is soluble in water. As a result, the milky appearance will disappear, and the solution will become clear again.
Equation: $CaCO_3$ (s) + CO_2 (g) + H_2O (l) → $Ca(HCO_3)_2$ (aq)

SLO Based Additional Long Questions
Q.1 Explain Bronsted-Lowry concepts of Acids and Bases.
Ans.
Bronsted-Lowry Acids:
An acid is a substance that donates a proton (H^+). 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. All Arrhenius acids are Bronsted-Lowry acids as well. For example, HCl dissociates in water to give H^+ and Cl^-. It also donates H^+ to H_2O forming H_3O^+.
$HCl + H_2O \rightarrow H_3O^+ + Cl^-$
Bronsted-Lowry Base:
A base is a substance that accepts a proton. For example, OH^-, NH_3, 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. All Arrhenius bases are, however, Bronsted-Lowry bases as well.

Bronsted-Lowry and Arrhenius Acid and Base:
All Bronsted-Lowry acids and bases are not Arrhenius acids and bases. NH_4^+ is not an Arrhenius acid, and NH_3 is not an Arrhenius base. 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 the gas phase or in the presence of any solvent.
Example (i): Consider the following reaction between hydrogen chloride gas and liquid water.
HCl (g) + H_2O (l) → H_3O^+ (aq) + Cl^- (aq)
(Acid) (Base)
In this reaction, HCl 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 an ammonium ion is formed.
NH_3 (g) + H_2O (l) ⇌ NH_4^+ (aq) + OH^- (aq)
(Base) (Acid) (Conjugate Acid) (Conjugate Base)
Ammonia is a base, while water is an acid in this reaction. Water has the ability to act both as an acid or a base depending upon the other compound with which it reacts.
Amphoteric Compound:
Water is therefore called an amphoteric compound, which means a compound that can behave both as an acid and a base.
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 NH_4^+ is the conjugate acid.
Examples: Some other examples of Bronsted-Lowry acids and bases.
$HSO_4^- + H_2O \rightleftharpoons SO_4^{2-} + H_3O^+$
(Acid) (Base) (Conjugate Base) (Conjugate Acid)

Q.2 Explain chemical Properties of Acids and Bases.

Ans. (a) Properties of Acids:

(i) Reaction of Acid with Metal Oxides and Alkalis: With alkalis or metal oxides, they form salts and water.

$H_2SO_4 + MgO \rightarrow MgSO_4 + H_2O$

$HCl + NaOH \rightarrow NaCl + H_2O$

(ii) Reaction of Acid with Metals: With reactive metals (Mg, Zn), they form salts and evolve hydrogen gas.

$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$ (g)

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

(iii) Reaction of Acid with Carbonates and Hydrogen Carbonates: They decompose metal carbonates and hydrogen carbonates, evolving carbon dioxide gas.

$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$ (g)

$NaHCO_3 + HCl \rightarrow NaCl + H_2O + CO_2$ (g)

(b) Properties of Alkalis

Alkalis are those bases which are soluble in water. Examples of alkalis are NaOH, KOH. $Ca(OH)_2$ is sparingly soluble in water, while $Cu(OH)_2$ is insoluble.

(i) Reaction of Alkalis and Acid: Alkalis react with acid to form salt and water.

$NaOH + HCl \rightarrow NaCl + H_2O$

(ii) Reaction of Alkalis with Ammonium Salt: Alkalis react with ammonium salts to liberate NH_3 gas.

$NaOH + NH_4Cl \rightarrow NaCl + H_2O + NH_3$ (g)

Q.1 Choose Arrhenius Acids among the following compounds: HF, NH_4^+, H_2SO_3, SO_3, H_2S, H_2O.

Ans. Arrhenius acids are substances that dissociate in water to give protons (H^+). Among the compounds, the Arrhenius acids are:

1. HF (Hydrofluoric acid)
2. H_2SO_3 (Sulphurous acid)
3. H_2S (Hydrogen sulphide)

These compounds release H^+ ions in solution.

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

Ans. When calcium metal reacts with dilute sulphuric acid (H_2SO_4), it undergoes a chemical reaction that produces calcium sulphate ($CaSO_4$), which is sparingly soluble in water, and hydrogen gas (H_2), which is released as bubbles. The overall reaction can be written as:

$Ca (s) + H_2SO_4 (aq) \rightarrow CaSO_4 (s) + H_2 (g)$

This reaction is exothermic, meaning it releases heat.

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

Ans. When hydrochloric acid (HCl) reacts with barium carbonate ($BaCO_3$), the products of the reaction are barium chloride ($BaCl_2$), water (H_2O), and carbon dioxide (CO_2). The overall reaction can be written as:

$BaCO_3 (s) + 2HCl (aq) \rightarrow BaCl_2 (aq) + H_2O (l) + CO_2 (g)$

So, the salt formed in this reaction is barium chloride ($BaCl_2$).

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

Ans. To justify that hydrogen sulphate ion (HSO_4^-) is a Bronsted-Lowry acid, we need to look at its ability to donate a proton (H^+). According to the Bronsted-Lowry definition, an acid is a substance that can donate a proton to a base. When HSO_4^- donates a proton, it transforms into SO_4^{2-} (sulphate ion).
HSO_4^- (aq) + H_2O (l) $\rightleftharpoons$ SO_4^{2-} (aq) + H_3O^+ (aq)
In this reaction, HSO_4^- donates a proton (H^+) and thus acts as a Bronsted-Lowry acid.

Q.5 What chemical name will you give to soap as a compound?
Ans. The chemical name commonly given to soap as a compound is **sodium stearate**. Sodium stearate is the sodium salt of stearic acid, which is a fatty acid. Soaps are typically formed through the saponification process, where a fat or oil reacts with an alkali, resulting in the formation of fatty acid salts, which are what we refer to as soap.

Q.6 Name some fruits which contain citric acid.
Ans. Lemon, Orange, and Grapefruit contain citric acid. All citrus fruits contain citric acid.

Q.7 In what ways are mineral acids useful for us?
Ans. Mineral acids like HCl, H_2SO_4, and HNO_3 are useful in several ways:

1. **Industrial Processes:** H_2SO_4 is essential in manufacturing fertilizers and cleaning metals.
2. **Food Industry:** Citric acid acts as a preservative and flavor enhancer.
3. **Cleaning Agents:** Combinations of acids are effective for removing rust and mineral deposits.
4. **Batteries:** Sulphuric acid is crucial in lead-acid batteries.

Q.8 How do chloride ions exist in water?

Ans. Chloride ions exist in water mainly from the dissolution of salts like sodium chloride (table salt). When NaCl dissolves, it breaks into sodium ions (Na^+) and chloride ions (Cl^-). The chloride ions are surrounded by water molecules, which stabilize them in the solution.

Q.9 Why does ammonium hydroxide only partially ionize in water?
Ans. Because ammonium hydroxide (NH_4OH) is a weak base. That's why it partially ionizes in water.
NH_4OH (aq) $\rightleftharpoons$ NH_4^+ (aq) + OH^- (aq)

Q.10 Give two examples of Bronsted-Lowry bases which are not bases by Arrhenius definition.
Ans. Two examples of Bronsted-Lowry bases that are not considered bases by Arrhenius definition are:

1. Ammonia (NH_3)
2. Bicarbonate (HCO_3^-) ion

SLO Based Additional Short Questions
Q.11 Write characteristic properties of acids.
Ans. Characteristic properties of acids:

1. Acids have a sour taste. For example, unripe citrus fruits or lemon juice.
2. They turn blue litmus red.
3. They are corrosive in concentrated form.
4. Their aqueous solutions conduct electric current.

Q.12 Differentiate between organic acids and mineral acids. Give examples.

Ans.

Organic Acids	Mineral Acids
(i) Acids which are obtained from natural sources are called natural or organic acids.	(i) Mineral or man-made acids are prepared from minerals like sodium chloride or sodium nitrate.
(ii) Some common organic acids are acetic acid (CH_3COOH), citric acid ($C_6H_8O_7$), and ascorbic acid ($C_6H_8O_6$).	(ii) Common examples of mineral acids are hydrochloric acid (HCl), sulphuric acid (H_2SO_4), and nitric acid (HNO_3).

Q.13 Write some names and sources of organic acids.
Ans.

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

Q.14 Why are metallic oxides basic in nature?
Ans. Metal oxides are basic in nature because they react with acids to form salt and water. For example, Na_2O is a basic oxide because it contains oxide ion (O^{2-}), which is a very strong base with a strong tendency to react with water to produce hydroxide ions.
$Na_2O\ (s) + H_2O\ (l) \rightarrow 2NaOH\ (aq)$

Q.15 Define neutralization reaction.
Ans. Both acids and alkalis are known to cancel the properties of each other when mixed together in equal amounts. The reaction is called a neutralization reaction. A salt and water are formed as a result of this reaction.
$HCl\ (aq) + NaOH\ (aq) \rightarrow NaCl\ (aq) + H_2O\ (l)$
(Acid) (Base) (Salt+Water)

Q.16 Write down the uses of oxalic acid.
Ans. Oxalic acid ($C_2H_2O_4$) is the simplest organic diprotic acid. Its commercial uses include bleaching straw and leather and removing rust and ink stains from fabrics.

Q.17 How are metallic oxides converted into hydroxides?

Ans. When metal oxides dissolve in water, they result in metal cations and oxide ions in aqueous solution. Because oxide ions are unstable in water, they immediately accept protons from water molecules and become hydroxide ions.

Example:

Metal oxide + water → Metal hydroxide

$MgO\ (s) + H_2O\ (l) \rightarrow Mg(OH)_2\ (aq)$

$MgO \rightarrow Mg^{2+} + O^{2-}$

$O^{2-} + H\text{-}OH \rightarrow 2OH^-$

Different Concepts of Acids and Bases

Q.18 Define Arrhenius acid. Give an example.

Ans. An acid is a substance that dissociates in water to give protons (H^+) or hydronium ions (H_3O^+). Some typical Arrhenius acids are HCl, HNO_3, H_2SO_4, and HCN.

Q.19 Define Arrhenius base. Give an example.

Ans. A base is a substance that dissociates in water to give hydroxyl ions (OH^-). Some typical Arrhenius bases are NaOH, KOH, and $Ba(OH)_2$.

Q.20 What is the role of water in the Arrhenius concept of acids and bases?

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

$H^+ + H_2O \rightarrow H_3O^+$

Q.21 Define a strong acid. Give examples.

Ans. An acid that ionizes completely in aqueous solution is called a strong acid. For example, HCl, HNO_3, and H_2SO_4 are strong acids. They ionize almost completely in aqueous solution. All the molecules of strong acids ionize in water.

$HCl\ (aq) \rightarrow H^+\ (aq) + Cl^-\ (aq)$

Q.22 Define a weak acid. Give an example.

Ans. Acids that do not ionize completely in aqueous solutions are called weak acids. Fewer molecules of weak acids ionize in water. For example, ethanoic acid (acetic acid), which is found in vinegar, ionizes only up to 5% in water. So, ethanoic acid is a weak acid.

$CH_3COOH\ (aq) \rightleftharpoons H^+\ (aq) + CH_3COO^-\ (aq)$

Q.23 Define a strong base. Give examples.

Ans. A base that ionizes completely in aqueous solution is termed as a strong base. For example, NaOH and KOH are strong bases.

$NaOH\ (aq) \rightarrow Na^+\ (aq) + OH^-\ (aq)$

Q.24 Define a weak base. Give an example.

Ans. A base that ionizes to a little extent is called a weak base. Such bases produce few OH^- ions in aqueous solution. For example, $Al(OH)_3$ and NH_3 are weak bases.

NH_3 (aq) + H_2O (l) $\rightleftharpoons$ NH_4^+ (aq) + OH^- (aq)

Q.25 Write down the limitations of the Arrhenius Concept.

Ans. Limitations of Arrhenius concept:

1. This concept is applicable only in an aqueous medium and does not explain the nature of acids and bases in a non-aqueous medium.
2. According to this concept, acids and bases are only those compounds which contain hydrogen (H^+) and hydroxyl (OH^-) ions, respectively. It cannot explain the nature of compounds like Na_2CO_3, K_2CO_3, and NH_3. They do not contain any hydroxyl group which will get ionized by water, but all these compounds behave as bases and yield OH^- in water.

Q.26 Why does HCl act as a strong acid?

Ans. HCl ionizes completely in aqueous solution. That's why HCl acts as a strong acid.

HCl (aq) $\rightarrow$ H^+ (aq) + Cl^- (aq)

Q.27 What is hyperacidity?

Ans. Stomach acidity or hyperacidity is a common condition. Most often, the problem arises when a person takes fatty and spicy food, which causes more acid to be produced in the stomach than required.

Q.28 How can hyperacidity be caused, and what are its symptoms?

Ans. Our stomach produces hydrochloric acid (HCl) to digest the food that we eat. Whenever we eat, cells within the lining of the stomach produce acid. A problem occurs when these cells produce more acid than your stomach needs. When it happens, the person suffers from stomach acidity. The common indication of such a condition is a feeling of a burning sensation right below our breastbone. A person may also feel a sour taste in the mouth and heartburn or pain near the heart area.

Q.29 How can hyperacidity be cured? / What are antacids?

Ans. The uneasy condition may easily be cured by taking weak bases like calcium hydroxide and magnesium hydroxide, commonly known as antacids. These antacids remove minor stomach disorders by neutralizing the stomach acid, but the concentration of hydroxyl ions in them is too low to harm the throat or stomach.

Bronsted - Lowry Concepts of Acids and Bases

Q.30 Define Bronsted-Lowry acid and base.

Ans. Bronsted-Lowry acid: An acid is a substance (molecule or ion) that can donate a proton (H^+) to another substance, e.g., HCl and CH_3COOH.

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

Bronsted-Lowry Base: A base is a substance that can accept a proton (H^+) from another substance, e.g., H_2O and NH_3.

NH_3 + H^+ $\rightarrow$ NH_4^+

Q.31 Why does NH_3 act as a Bronsted-Lowry base?

Ans. Ammonia (NH_3) acts as a base in water. When it is dissolved in water, it can accept a proton (H^+) from water and form an ammonium ion (NH_4^+).

$NH_3 (g) + H_2O (l) \rightleftharpoons NH_4^+ (aq) + OH^- (aq)$

Q.32 Define neutralization reaction according to the Bronsted-Lowry concept.

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

$HCl (g) + H_2O (l) \rightarrow H_3O^+ (aq) + Cl^- (aq)$

Q.33 What is the difference between an Arrhenius base and a Bronsted-Lowry base?

Ans. Arrhenius base: A base is a substance that dissociates in an aqueous solution to give hydroxide ions (OH^-).

$NaOH (aq) \rightarrow Na^+ (aq) + OH^- (aq)$

Bronsted-Lowry base: A base is a substance that can accept a proton (H^+) from another substance.

$NH_3 (g) + H^+ (aq) \rightarrow NH_4^+ (aq)$

Q.34 What do you mean by neutralization reaction according to the Arrhenius acid-base concept?

Ans. According to the Arrhenius concept, acids give (H^+) ions and bases give (OH^-) ions. During a neutralization reaction, hydrogen ions (H^+) combine with an equal number of hydroxide ions (OH^-), and both neutralize each other to form water.

$H^+ (aq) + OH^- (aq) \rightarrow H_2O (l)$

Q.35 Prove that water is an amphoteric species.

Ans. Water is an amphoteric species because it acts as an acid as well as a base. When it reacts with a base, it acts as an acid, and it acts as a base when it reacts with an acid.

Water acting as acid:

$H_2O (l) + NH_3 (g) \rightleftharpoons OH^- (aq) + NH_4^+ (aq)$

(Acid) (Base)

Water acting as base:

$H_2O (l) + HCl (g) \rightarrow H_3O^+ (aq) + Cl^- (aq)$

(Base) (Acid)

Q.36 How can you justify that NH_3 is a Bronsted-Lowry base but not an Arrhenius base?

Ans. Ammonia is a Bronsted-Lowry base because it has the ability to accept a proton (H^+). However, it is not an Arrhenius base because it does not contain a hydroxyl group and does not produce hydroxide ions (OH^-) itself. Instead, it reacts with water to generate them.

Properties of Acids and Bases

Q.37 Define alkali.

Ans. A base that is soluble in water is called an alkali. This means that all bases are not alkalis. On the other hand, all alkalis are bases. Many bases do not dissolve in water. For example, copper hydroxide $Cu(OH)_2$, aluminum hydroxide $Al(OH)_3$, and ferric hydroxide $Fe(OH)_3$.

Q.38 When acids react with carbonates and bicarbonates, which gas evolves?

Ans. When acids react with carbonates and bicarbonates, carbon dioxide (CO_2) gas evolves.
Example: $CaCO_3$ (s) + 2HCl (aq) → $CaCl_2$ (aq) + H_2O (l) + CO_2 (g)

Q.39 When an acid reacts with a metal, which gas evolves?
Ans. When an acid reacts with a metal (Mg, Zn), it forms salts and evolves hydrogen gas.
Example: Zn (s) + H_2SO_4 (aq) → $ZnSO_4$ (aq) + H_2 (g)

Q.40 Name the gas liberated when alkalis react with ammonium salts.
Ans. Alkalis react with ammonium salts to liberate ammonia gas (NH_3).
Example: NaOH (aq) + NH_4Cl (aq) → NaCl (aq) + H_2O (l) + NH_3 (g)

Q.41 How to clean a blocked drain? / What are caustic chemical drain cleaners?
Ans. One of the ways to clean a 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. Then, pour boiling water down the drain. Caustic chemical drain cleaners are capable of dissolving grease, hair, food, and other common blockages. Pour down the caustic cleaner into your drain. Wait for half an hour and then flush your drain with water.

Acid Rain and its Effects
Q.42 Define Acid Rain. How is it formed?
Ans. When rainwater has a pH less than 5.6, it is called acid rain. The burning of fossil fuels releases harmful gases into the air. These gases (SO_2 and NO_2) when mixed with moisture present in the air form acid droplets. These droplets then fall to the ground as acid rain.

Q.43 What are the effects of acid rain?
Ans.
1. Effects on Soil: Acid rain makes soil more acidic. It dissolves and washes away nutrients present in the soil that are needed by plants. Many plants cannot live or grow in acidic soil. It can damage vegetation.
2. Effect on Aquatic Life: Acid rain can make the water of water bodies too acidic for aquatic animals to live in. Due to this, many lakes, rivers, ponds, and streams no longer have fish.
3. Effect on Buildings: Acid rain and the dry deposition of acidic particles damage buildings, statues, automobiles, and other structures made of stone and metal.

Constructed Response Question
Q.1 (Ex. Q. 3 (i)) What chemical name will you give to soap as a compound?
Ans. The chemical name for soap depends on its composition. Most soaps are salts of fatty acids. For example:

- **Sodium stearate:** Common in solid soaps.
- **Potassium oleate:** Found in liquid soaps.
  Soap can be described as a salt of a carboxylic acid (e.g., sodium or potassium salts of long-chain fatty acids).

Q.2 (Ex.Q. 3 (ii)) In the presence of a drop of an acid, water is known to ionize as follows: $H_2O \rightleftharpoons H^+ + OH^-$. In your opinion, which name will be suitable for water: an acid, a base or both?
Ans. In the context of acid-base chemistry, water can be classified as both an acid and a base. This is because water has the ability to donate a proton (H^+) to a base, making it an acid, and it can also

accept a proton from an acid, making it a base. This dual nature of water is described by the Bronsted-Lowry theory of acids and bases. When water donates a proton, it forms hydroxide ions (OH^-), and when it accepts a proton, it forms hydronium ions (H_3O^+). So, water is considered amphoteric, meaning it can act as both an acid and a base depending on the circumstances.

Q.3 (Ex.Q. 3 (iii)) Why does Na_2CO_3 behave like a base in water?

Ans. Sodium carbonate (Na_2CO_3) behaves like a base in water due to its ability to dissociate into sodium ions (Na^+) and carbonate ions (CO_3^{2-}) when dissolved in water.

When sodium carbonate is added to water, it dissociates as follows:

$Na_2CO_3\ (s) \rightarrow 2Na^+\ (aq) + CO_3^{2-}\ (aq)$

The carbonate ions (CO_3^{2-}) can react with water in a process called hydrolysis. During this reaction, carbonate ions can accept hydrogen ions (H^+) from water, leading to the formation of bicarbonate ions (HCO_3^-) and hydroxide ions (OH^-).

$CO_3^{2-}\ (aq) + H_2O\ (l) \rightleftharpoons HCO_3^-\ (aq) + OH^-\ (aq)$

The production of hydroxide ions (OH^-) increases the pH of the solution, making it more basic. This is why sodium carbonate is considered a basic compound when dissolved in water.

Q.4 (Ex.Q. 3 (iv)) Is $NaHCO_3$ a base or an acid?

Ans. $NaHCO_3$, or sodium bicarbonate, is generally considered a weak base. When dissolved in water, it can partially dissociate into sodium ions (Na^+) and bicarbonate ions (HCO_3^-).

$NaHCO_3\ (s) \rightarrow Na^+\ (aq) + HCO_3^-\ (aq)$

The bicarbonate ion (HCO_3^-) can act as a base by accepting a proton (H^+) from an acid, which can lead to the formation of carbonic acid (H_2CO_3).

$HCO_3^-\ (aq) + H^+\ (aq) \rightarrow H_2CO_3\ (aq)$

This ability to accept protons is what gives sodium bicarbonate its basic properties. However, it can also act as a weak acid when it donates a proton, making it amphoteric.

Q.5 (Ex. Q. 3 (v)) What is the difference between a strong acid and a concentrated acid?

Strong Acid

A strong acid is an acid that completely dissociates into its ions in water. This means that when a strong acid is dissolved in water, all of its molecules break apart into hydrogen ions (H^+) and the corresponding anions.

- Examples of strong acids include hydrochloric acid (HCl), sulphuric acid (H_2SO_4), and nitric acid (HNO_3).

Concentrated Acid

A concentrated acid refers to the amount of acid present in a solution relative to the amount of water. A concentrated acid has a high concentration of acid molecules. Concentration is typically expressed in moles per liter (M).

- For example, you can have concentrated hydrochloric acid, which is a strong acid, but you can also have a diluted version of hydrochloric acid, which would still be a strong acid but with a lower concentration.

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 will calcium hydroxide 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
   (c) 3 ✔
   (d) 4
6. Which acid is used in 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) $H_2S_2O_7$
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? $CH_3COO^- + H_3O^+ \rightleftharpoons CH_3COOH\ (aq) + H_2O\ (l)$
   (a) CH_3COOH
   (b) H_2O ✔
   (c) CH_3COO^-
   (d) H_3O^+
   (Note: In this reaction, CH_3COO^- is accepting a proton to form CH_3COOH, so CH_3COO^- is the base and CH_3COOH is its conjugate acid. H_3O^+ is the acid and H_2O is its conjugate base. The correct answer is H_2O.)

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 ✔
    (Note: The gas that turns red litmus blue is NH_3, which is produced when an alkali reacts with an ammonium salt.)
11. A base is a substance which neutralizes an acid. Which of these substances is not a base?
    (a) aqueous ammonia
    (b) sodium chloride ✔
    (c) sodium carbonate
    (d) calcium oxide
12. Acetic acid is used for:
    (a) flavouring food ✔
    (b) making explosives
    (c) etching designs
    (d) cleaning metals
13. Acids means:
    (a) sour ✔
    (b) bitter
    (c) sweet
    (d) salty
14. All acids turn blue litmus:
    (a) red ✔
    (b) colourless
    (c) pink
    (d) white
15. All bases turn red litmus:
    (a) colorless
    (b) blue ✔
    (c) pink
    (d) white

Arrhenius Concepts of Acids and Bases

16. Which of the following cannot be classified as Arrhenius acid?
    (a) HNO_3
    (b) H_2CO_3
    (c) CO_2 ✔
    (d) H_2SO_4
17. Milk of magnesia contains $Mg(OH)_2$. It is used as 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
    (Note: Stomach acid is HCl, so the reaction is $Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + 2H_2O$.)

18. According to the Arrhenius concept, an acid is a substance which dissociates in an aqueous solution to give:
    (a) hydrogen ions ✔
    (b) hydroxide ions
    (c) protons
    (d) pair of electrons
19. According to the Arrhenius concept, a base is a substance which dissociates in an aqueous solution to give:
    (a) hydrogen ions
    (b) hydroxide ions ✔
    (c) protons
    (d) pair of electrons
20. Which one is not an Arrhenius base?
    (a) NaOH
    (b) KOH
    (c) $Ca(OH)_2$
    (d) NH_3 ✔
21. Which one is not an Arrhenius acid?
    (a) HCl
    (b) H_2SO_4
    (c) CO_2 ✔
    (d) HNO_3

Bronsted-Lowry Concepts of Acids and Bases

22. Which of the following is a Bronsted base?
    (a) NH_3 ✔
    (b) HCl
    (c) CH_3COOH
    (d) H_3O^+
23. Ammonia is a base, because it:
    (a) Ionizes in water to give OH^- ions
    (b) Contains an OH group
    (c) Can accept an electron pair
    (d) Can accept a proton ✔
24. Consider the following reaction: $H_2O + HCl \rightarrow H_3O^+ + Cl^-$. Which species is a proton acceptor in this reaction?
    (a) H_2O ✔
    (b) HCl
    (c) H_3O^+
    (d) none
25. According to the Bronsted and Lowry concept, an acid is a substance that can donate:
    (a) a proton ✔
    (b) an electron pair
    (c) a neutron
    (d) an electron
26. A substance which can behave as an acid as well as a base is called:
    (a) acid
    (b) base

(c) amphoteric species ✔
(d) neutral species

Properties of Acid and Bases

27. A reaction between an acid and a base produces:
    (a) salt and water ✔
    (b) salt and gas
    (c) salt and an acid
    (d) salt and a base
28. Which acid is present in our stomach?
    (a) nitric acid
    (b) hydrochloric acid ✔
    (c) sulphuric acid
    (d) all of the above
29. When acids react with metals, which gas is evolved?
    (a) H_2 ✔
    (b) O_2
    (c) Cl_2
    (d) N_2
30. When acids react with carbonates and bicarbonates, which gas is produced?
    (a) H_2
    (b) CO_2 ✔
    (c) Cl_2
    (d) N_2

31. Alkalis react with ammonium salts to liberate:
    (a) SO_2
    (b) CO_2
    (c) NH_3 ✔
    (d) H_2
32. Which is used to manufacture soap?
    (a) NaOH ✔
    (b) $Ca(OH)_2$
    (c) NH_4OH
    (d) $Mg(OH)_2$
33. Acid rain has a pH less than:
    (a) 7
    (b) 6
    (c) 4
    (d) 5.6 ✔
34. Caustic chemical drain cleaners are capable of dissolving:
    (a) Grease
    (b) Hair
    (c) Food
    (d) All of these ✔