# 9th Class Chemistry Chapter # 7 Exercise Solutions – Punjab Board

## Acid base Chemistry

## Multiple Choice Questions (MCQs)

**(i) Which acid is not used as a food or mixed with food?**

**Options:**

- (a) Tartaric acid
- (b) Acetic acid
- (c) Citric acid
- (d) Formic acid

**Correct Answer:** (d) **Formic acid**

**Explanation:**
Formic acid is **toxic** and **not used in food**. The other acids are commonly found in foods or used as preservatives/flavouring agents.

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**(ii) While baking, which gas is responsible for raising the bread and making it soft?**

**Options:**

- (a) Oxygen
- (b) Carbon dioxide
- (c) Nitrogen
- (d) Carbon monoxide

**Correct Answer:** (b) **Carbon dioxide**

**Explanation:**
Baking powder or baking soda reacts to produce **$CO_2$ gas**, which forms bubbles and causes the dough to **rise and soften**.

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**(iii) Predict the main characteristics of the reactions of metals with acids.**

**Options:**

- (a) Metals are dissolved
- (b) Metals are converted into salts
- (c) Hydrogen gas is evolved
- (d) All the above mentioned characteristics are true

**Correct Answer:** (d) **All the above mentioned characteristics are true**

**Explanation:**
Acids react with metals to:

- Dissolve the metal
- Form a **salt**
- Release **hydrogen gas**

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## (iv) How many hydroxide ions, calcium hydroxide will release in water?

**Options:**

- (a) 1
- (b) 2
- (c) Zero
- (d) 3

**Correct Answer:** (b) **2**

**Explanation:**
Calcium hydroxide Ca(OH)2is a **strong base** and releases **2 $OH^-$ ions** per formula unit in aqueous solution.

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## (v) In a neutralization reaction between KOH and $H_3PO_4$, how many molecules of KOH will react with one molecule of $H_3PO_4$?

**Options:**

- (a) 2
- (b) 1
- (c) 3
- (d) 4

**Correct Answer:** (c) **3**

**Explanation:**
Phosphoric acid H3PO4 is a **triprotic acid** (releases 3 $H^+$). Potassium hydroxide KOH provides **1 $OH^-$** per molecule. So, **3 KOH molecules** are required to neutralize 1 $H_3PO_4$.

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## (vi) Which acid is used in the preparation of soap?

**Options:**

- (a) Tartaric acid
- (b) Citric acid
- (c) Acetic acid
- (d) Oleic acid

**Correct Answer:** (d) **Oleic acid**

**Explanation:**
Soap is made by **saponification** of fats and oils, which often contain **oleic acid**, a **fatty acid**.

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## (vii) Which compound is formed when $SO_2$ is dissolved in water?

**Options:**

- (a) $SO_3$
- (b) $H_2SO_3$
- (c) $H_2SO_4$
- (d) $H_2S_2O_3$

**Correct Answer:** (b) **$H_2SO_3$**

**Explanation:**
Sulphur dioxide SO2 dissolves in water to form **sulphurous acid**:

SO2+H2O→H2SO3

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### (viii) Which of the following contains oxalic acid?

**Options:**

- (a) Tomato
- (b) Orange
- (c) Tamarind
- (d) Sour milk

**Correct Answer:** (a) **Tomato**

**Explanation:**
**Tomatoes** are rich in **oxalic acid**, which gives them a slightly sour taste.

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### (ix) Which compound in the following reaction is behaving as a conjugate base?

$CH3COOH(aq)+H2O(l) \rightleftharpoons CH3COO+H3O$

**Options:**

- (a) $CH_3COOH$
- (b) $H_2O$
- (c) $CH_3COO^-$
- (d) $H_3O^+$

**Correct Answer:** (c) **$CH_3COO^-$**

**Explanation:**
**$CH_3COO^-$** is formed when **$CH_3COOH$** donates a proton ($H^+$), so it acts as the **conjugate base** of the acid.

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### (x) 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?

**Options:**

- (a) Reaction of an acid with a metal carbonate
- (b) Reaction of an acid with metal hydrogen carbonate
- (c) Reaction of an alkali with an acid

- (d) Reaction of an alkali with ammonium salt

**Correct Answer:** (d) **Reaction of an alkali with ammonium salt**

**Explanation:**
This reaction produces **ammonia gas ($NH_3$)**, which is **basic** in nature and turns **red litmus blue**.

## Questions for Short Answers

### i. Choose Arrhenius Acids among the following compounds:

**HF, $NH_3$, $H_2SO_4$, $SO_3$, $H_2S$, $H_2O$**

**Answer:**

According to **Arrhenius definition**, an acid is a substance that **increases the concentration of $H^+$ (or $H_3O^+$) ions** in aqueous solution.

**Arrhenius acids among the given are:**

- **HF** (hydrofluoric acid)
- **$H_2SO_4$** (sulphuric acid)
- **$H_2S$** (hydrosulphuric acid)

**Not acids (as per Arrhenius):**

- **$NH_3$** – Base (gives $OH^-$ in water indirectly)
- **$SO_3$** – Acidic oxide, not an acid itself until it reacts with water
- **$H_2O$** – Neutral, acts as both acid or base depending on conditions

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### ii. How does calcium metal react with dilute $H_2SO_4$?

**Answer:**

Calcium metal reacts with **dilute sulphuric acid ($H_2SO_4$)** to form **calcium sulphate ($CaSO_4$)** and **hydrogen gas ($H_2$)**.

Ca(s)+H2SO4(aq)→CaSO4(aq)+H2(g)

**Observation:**

- Effervescence of hydrogen gas is seen.
- It's an example of **metal + acid → salt + hydrogen** reaction.

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## iii. Which salt is formed when HCl reacts with $BaCO_3$?

**Answer:**

When **hydrochloric acid (HCl)** reacts with **barium carbonate ($BaCO_3$)**, the products are:

- **Barium chloride ($BaCl_2$)**
- **Water ($H_2O$)**
- **Carbon dioxide ($CO_2$)**

$$BaCO3+2HCl \rightarrow BaCl2+H2O+CO2\uparrow$$

**Salt formed: Barium chloride ($BaCl_2$)**

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## iv. How will you justify that $HSO_4^-$ is a Bronsted-Lowry acid?

**Answer:**

According to the **Bronsted-Lowry definition**, an acid is a substance that **donates a proton ($H^+$)**.

$HSO_4^-$ can lose a proton to form $SO_4^{2-}$:

$$HSO4^- \rightleftharpoons H^+ + SO42$$

Since it **donates $H^+$**, it behaves as a **Bronsted-Lowry acid**.

**Conclusion:** $HSO_4^-$ is a **weak acid** that donates a proton, fitting Bronsted-Lowry definition.

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### v. Why is HCl not edible although it is present in the stomach and responsible for digestion of food?

**Answer:**

Hydrochloric acid (**HCl**) in the stomach:

- Helps in digestion by **activating enzymes** and **breaking down food**.
- It is present in **very dilute form** (around 0.5%–1%) in gastric juice.

But **concentrated HCl** is:

- **Corrosive and highly acidic**
- Can **burn tissues, damage mouth and esophagus**, and is **dangerous to health**

**Conclusion:** HCl is **not edible** in its concentrated form because it is **harmful and corrosive**, though a **dilute amount naturally exists in the stomach** for digestion.

## Constructed Response Questions

### i. What chemical name will you give to soap as a compound?

**Answer:**

**Soap** is chemically a **salt of a fatty acid**.

When a **fat or oil** reacts with **sodium hydroxide (NaOH)** during saponification, it produces **sodium salt of long-chain fatty acid** — commonly called **soap**.

**Chemical name of soap:**
**Sodium stearate ($C_{17}H_{35}COONa$)** – if made from stearic acid.

**Conclusion:** Soap is generally a **sodium or potassium salt of a fatty acid**.

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

$H2O \rightleftharpoons H+ + OH-$

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

**Answer:**

Water is a **neutral molecule**, but it can **donate or accept a proton ($H^+$)** depending on what it reacts with.

- In presence of a **strong acid**, water **accepts $H^+$** → acts as a **base**
- In presence of a **strong base**, water **donates $H^+$** → acts as an **acid**

**Conclusion:**
Water is **amphoteric**, i.e., it behaves as **both acid and base**, depending on the reacting substance.

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## iii. Why does $Na_2CO_3$ behave like a base in water?

**Answer:**

**Sodium carbonate ($Na_2CO_3$)** dissociates in water to give:

$Na2CO3 \rightarrow 2Na^{++} CO32^-$

The **carbonate ion ($CO_3^{2-}$)** is a **weak base** and **reacts with water** to form **$OH^-$ ions**:

$CO3 + H2O \rightleftharpoons HCO3 + OH$

This increase in **$OH^-$ ions** makes the solution **basic**.

**Conclusion:**
$Na_2CO_3$ behaves like a **base** because it produces **hydroxide ions ($OH^-$)** in water due to hydrolysis.

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## iv. Is $NaHCO_3$ a base or an acid? Justify your answer.

**Answer:**

**Sodium hydrogen carbonate ($NaHCO_3$)**, also called **baking soda**, is a **basic salt**.

It comes from a **strong base (NaOH)** and a **weak acid ($H_2CO_3$)**.

In water:

$$NaHCO3 \rightleftharpoons Na^{++}HCO3$$

Then:

$$HCO3^{-}+H2O \rightleftharpoons H2CO3+OH$$

This reaction **releases $OH^-$ ions**, making the solution **basic**.

**Conclusion:**
**$NaHCO_3$ is a weak base**, as it produces **$OH^-$ ions** in water. However, it can also act as a **weak acid** in the right conditions, so it is **amphiprotic** but **mostly basic in water**.

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## v. What is the difference between a strong acid and a concentrated acid?

**Answer:**

| Strong Acid | Concentrated Acid |
|---|---|
| Completely **ionizes** in water | Has **less water** (more acid per unit volume) |
| Depends on **chemical strength** | Depends on **amount of acid in solution** |
| Example: HCl (strong even if dilute) | Example: Glacial acetic acid (concentrated but weak) |
| Strength ≠ concentration | Concentration ≠ strength |

**Conclusion:**

- A **strong acid** refers to the **degree of ionization**.
- A **concentrated acid** refers to the **amount of acid** present in a given volume.

# Descriptive Questions

## i. Explain Arrhenius concept of acids and bases.

**Answer:**

**Arrhenius Concept (1884)** defines acids and bases based on **ionization in water**:

- **Arrhenius Acid**: A substance that **increases $H^+$ ions** (or $H_3O^+$) in aqueous solution.
  Example:
  $HCl \rightarrow H^+ + Cl^-$
- **Arrhenius Base**: A substance that **increases $OH^-$ ions** in aqueous solution.
  Example:
  $NaOH \rightarrow Na^+ + OH^-$

**Limitation:**

- Only applies to **aqueous solutions**.
- Cannot explain **basic nature of substances like $NH_3$**.

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## ii. Compare Arrhenius and Bronsted-Lowry concepts of acids and bases.

**Answer:**

| Property | Arrhenius Concept | Bronsted-Lowry Concept |
|---|---|---|
| **Acid** | Produces $H^+$ in water | Donates a proton ($H^+$) |
| **Base** | Produces $OH^-$ in water | Accepts a proton ($H^+$) |

| Property | Arrhenius Concept | Bronsted-Lowry Concept |
|---|---|---|
| **Medium** | Only aqueous | Any solvent or gas phase |
| **Example Acid** | $HCl \rightarrow H^+ + Cl^-$ | HCl donates $H^+$ to $H_2O$ |
| **Example Base** | $NaOH \rightarrow Na^+ + OH^-$ | $NH_3 + H_2O \rightarrow NH_4^+ + OH^-$ |
| **Limitation** | Only $OH^-$ bases allowed | Covers more acid–base pairs |

**Conclusion:**
Bronsted–Lowry theory is **broader** and explains acid–base behavior in **non-aqueous media** too.

## v. State the reason of showing acidic character by both dry HCl gas and HCl solution in water.

**Answer:**

- **Dry HCl gas** is **not acidic** — it **does not ionize** in the absence of water.
- In **water**, HCl ionizes completely:
  $HCl + H2O \rightarrow H3O^+ + Cl^-$
  – It shows **acidic character** (turns blue litmus red, reacts with metals, etc.)

**Conclusion:**
Only **aqueous HCl** acts as an **Arrhenius acid**. **Dry HCl gas doesn't show acidic properties** until it **dissolves in water** and **releases $H^+$ ions**.

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## vi. Differentiate between an acid and its conjugate base.

**Answer:**

| Acid | Conjugate Base |
| --- | --- |
| Donates a proton ($H^+$) | Formed after acid loses a proton |
| Strong acid → weak conjugate base | Weak acid → strong conjugate base |
| Example: HCl (acid) | $Cl^-$ (conjugate base) |
| Example: $CH_3COOH$ | $CH_3COO^-$ |

**Conclusion:**
When an acid **loses a proton**, it becomes its **conjugate base**, capable of **accepting a proton** in the reverse reaction.

# Investigative Questions

## i. Acids play significant roles within human body. Comment on this statement.

**Answer:**

Yes, **acids play essential and diverse roles in the human body**. Some key examples include:

### 1. Hydrochloric Acid (HCl) in the stomach:

- Secreted by **gastric glands**.
- Helps in **digestion of food** by:
  - Activating enzymes like **pepsin**.
  - Killing harmful **microorganisms**.
  - Maintaining an **acidic pH (~1.5–3.5)** for proper digestion.

### 2. Amino acids:

- Building blocks of **proteins**, essential for growth and repair.
- Each amino acid contains an **acidic group (-COOH)**.

**3. Fatty acids:**

- Components of **lipids**, important for **energy storage** and **cell membrane structure**.

**4. Nucleic acids (DNA and RNA):**

- Carry genetic information.
- Composed of **phosphoric acid**, sugars, and nitrogenous bases.

**Conclusion:**
Acids are **vital for digestion, metabolism, energy production, and genetic function** in the human body.

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## ii. What is observed when $CO_2$ is passed through lime water:

**(i) for a short duration**
**(ii) for a long duration**

**Answer:**

**Chemical used:**
**Lime water** is a **dilute solution of calcium hydroxide: $Ca(OH)_2$**

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**(i) For a short duration:**

$CO2+Ca(OH)2 \rightarrow CaCO3\downarrow +H2O$

- **Calcium carbonate ($CaCO_3$)** forms as a **white precipitate**.
- **Observation:** Lime water turns **milky**.

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**(ii) For a long duration:**

$CaCO3+CO2+H2O \rightarrow Ca(HCO3)2$

- The **white precipitate dissolves** and **solution becomes clear** again.
- This is due to formation of **calcium hydrogen carbonate (soluble)**.

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**Conclusion:**

- Short duration → **Milky appearance** (due to $CaCO_3$)
- Long duration → **Milkiness disappears** (due to formation of soluble $Ca(HCO_3)_2$)