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9th CLASS • CHEMISTRY

CHAPTER 07

ACID BASE CHEMISTRY

Complete Solved Exercise

MCQs with Explanations

Short • Constructed

Descriptive • Investigative



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E Exercise

Chapter 07 • Acid Base Chemistry • Fully solved with explanations, step by step.

1 Tick (✓) the correct answer.**(i)**

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

(a) Tartaric acid

(b) Ascorbic acid

(c) Citric acid

✓ **(d) Formic acid**

✓ **Correct Answer: (d) Formic acid**

Explanation: Tartaric acid, ascorbic acid (Vitamin C), and citric acid are naturally found in various fruits and are safe for consumption. Formic acid, however, is found in the venom of ants and bee stings. It is highly corrosive and toxic, making it completely unsuitable for human consumption.

(ii)

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

(a) Oxygen

✓ **(b) Carbon dioxide**

(c) Nitrogen

(d) Carbon monoxide

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

Explanation: Baking powder contains sodium bicarbonate (baking soda) and a dry acid. When mixed with water, they react to produce carbon dioxide gas. This gas gets trapped inside the dough, creating bubbles that cause the bread to rise and become soft and spongy.

(iii)

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

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

Explanation: When a metal reacts with an acid, it undergoes a single displacement reaction. The metal dissolves in the acid, replaces the hydrogen from the acid to form a salt, and hydrogen gas is released as bubbles (evolved).

(iv)

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

(a) 1

**(b) 2**

(c) Zero

(d) 3

✓ **Correct Answer: (b) 2**

Explanation: The chemical formula for calcium hydroxide is Ca(OH)_2 . When it dissolves in water, it dissociates into one calcium ion (Ca^{2+}) and two hydroxide ions (OH^-) according to the equation: $\text{Ca(OH)}_2 \rightarrow \text{Ca}^{2+} + 2\text{OH}^-$.

(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 ?

(a) 2

(b) 1

✓ (c) 3

(d) 4

✓ **Correct Answer: (c) 3**

Explanation: H_3PO_4 (Phosphoric acid) is a triprotic acid, meaning it has three replaceable hydrogen ions. KOH (Potassium hydroxide) provides one hydroxide ion.

Therefore, it takes three molecules of KOH to completely neutralize one molecule of H_3PO_4 : $3\text{KOH} + \text{H}_3\text{PO}_4 \rightarrow \text{K}_3\text{PO}_4 + 3\text{H}_2\text{O}$.

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

(a) Tartaric acid

(b) Citric acid

✓ **(c) Stearic acid**

(d) Oxalic acid

✓ **Correct Answer: (c) Stearic acid**

Explanation: Soaps are chemically defined as sodium or potassium salts of long-chain carboxylic acids (fatty acids). Stearic acid ($C_{17}H_{35}COOH$) is a common saturated fatty acid used in the saponification process to make soap.

(vii)

Which compound is formed when SO_2 is dissolved in water?

(a) SO_3 ✓ (b) H_2SO_3 (c) H_2SO_4 (d) $\text{H}_2\text{S}_2\text{O}_7$ ✓ **Correct Answer: (b) H_2SO_3**

Explanation: Sulfur dioxide (SO_2) is an acidic oxide. When it is dissolved in water, it reacts to form sulfurous acid (H_2SO_3). The balanced equation is: $\text{SO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_3$.

(viii) Which of the following contains oxalic acid?

✓ **(a) Tomato**

(b) Orange

(c) Tamarind

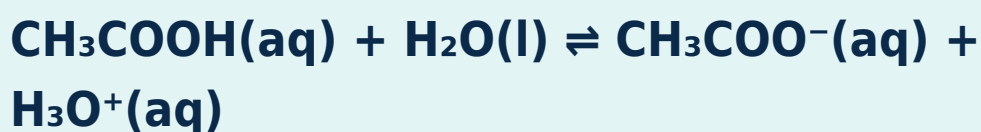
(d) Sour milk

✓ **Correct Answer: (a) Tomato**

Explanation: Tomatoes naturally contain oxalic acid. Oranges contain citric acid, tamarind contains tartaric acid, and sour milk contains lactic acid.

(ix)

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

(a) CH_3COOH (b) H_2O ✓ (c) CH_3COO^- (d) H_3O^+ ✓ **Correct Answer: (c) CH_3COO^-**

Explanation: According to the Bronsted-Lowry theory, an acid donates a proton (H^+) and a base accepts it. Here, CH_3COOH donates a proton to H_2O . The species that remains after the acid (CH_3COOH) loses a proton is called its conjugate base. Therefore, CH_3COO^- is the conjugate base of CH_3COOH .

(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?

- (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: Red litmus paper turning blue indicates the presence of a base (alkaline gas). When an alkali (like NaOH) reacts with an ammonium salt (like NH_4Cl), ammonia gas (NH_3) is produced. Ammonia is basic in nature and turns red litmus paper blue: $\text{NaOH} + \text{NH}_4\text{Cl} \rightarrow \text{NaCl} + \text{NH}_3 + \text{H}_2\text{O}$.

2 Questions for Short Answers

i.

Choose Arrhenius Acids among the following compounds.

HF, NH₃, H₂SO₄, SO₃, H₂S, H₂O

Answer: Arrhenius acids are substances that produce hydrogen ions (H⁺) when dissolved in water. Among the given compounds, the Arrhenius acids are:

- **HF** (Hydrofluoric acid)
- **H₂SO₄** (Sulfuric acid)
- **H₂S** (Hydrosulfuric acid)

(Note: NH₃ is a base, SO₃ is an acidic oxide, and H₂O is neutral/amphoteric).

ii.

How does calcium metal react with dilute H₂SO₄?

Answer: Calcium metal reacts with dilute sulfuric acid to form calcium sulfate and hydrogen gas.

Equation:



Note: The reaction starts vigorously but soon slows down and stops because calcium sulfate is sparingly soluble in water. It deposits on the surface of the calcium metal, forming a protective coating that prevents further contact with the acid.

iii.

Which salt is formed when HCl reacts with BaCO₃?

Answer: When hydrochloric acid (HCl) reacts with barium carbonate (BaCO₃), it forms **Barium chloride (BaCl₂)** salt, along with water and carbon dioxide gas.

Equation:



iv.

How will you justify that HSO₄⁻ is a Bronsted - Lowry acid?

Answer: According to the Bronsted-Lowry theory, an acid is defined as a proton (H⁺) donor. HSO₄⁻ (hydrogen sulfate ion) can donate a proton to a base (like water) to form SO₄²⁻ (sulfate ion).

Equation:



Since HSO_4^- donates a proton (H^+) in this reaction, it acts as a Bronsted-Lowry acid.

v.

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

Answer: The hydrochloric acid (HCl) present in the human stomach is highly dilute (around 0.1M) and is safely secreted by gastric glands. The stomach lining is protected by a thick layer of mucus and bicarbonate ions. However, if concentrated HCl (the commercial liquid) is consumed, it is extremely corrosive. It will cause severe chemical burns to the mouth, throat, esophagus, and stomach lining, leading to fatal consequences. Therefore, it is not edible in its concentrated form.

3 Constructed Response Questions

i.

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

Answer: Chemically, soap is a **sodium or potassium salt of a long-chain fatty acid** (carboxylic acid). For example, the common soap sodium stearate is chemically named *Sodium Octadecanoate*.

ii.

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



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

Answer: Water is **amphoteric**, meaning it can act as both an acid and a base. In the given equation, forward reaction shows water acting as an acid by donating a proton (H^+) to form OH^- . However, water can also accept a proton (e.g., reacting with HCl to form H_3O^+), acting as a base. Therefore, "both" is the most suitable name.

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

Answer: Na_2CO_3 (Sodium carbonate) is a salt of a strong base (NaOH) and a weak acid (H_2CO_3). When dissolved in water, it undergoes hydrolysis. The carbonate ion (CO_3^{2-}) accepts a proton from water, leaving an excess of hydroxide ions (OH^-) in the solution.

Equation:



Since the concentration of OH^- ions increases, the solution becomes basic, and Na_2CO_3 behaves like a base.

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

Answer: NaHCO_3 (Sodium bicarbonate) is **amphoteric** (can act as both a weak acid and a weak base), but it is generally considered a **mild base**.

Justification: When dissolved in water, it produces hydroxide ions (OH^-), making the solution slightly basic. It reacts with acids to neutralize them (e.g., $\text{NaHCO}_3 + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$), which is a basic property. However, it can also react with strong bases (e.g., $\text{NaHCO}_3 + \text{NaOH} \rightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O}$), acting as an acid. Due to its primary reaction with acids, it is often classified as a basic salt.

v.

What is the difference between a strong acid and a concentrated acid?

Answer:

- **Strong Acid:** Refers to the degree of ionization. A strong acid completely dissociates into ions (H^+ and anions) in an aqueous solution. Examples: HCl , HNO_3 , H_2SO_4 .
- **Concentrated Acid:** Refers to the amount of acid present in a solution relative to the solvent (usually water). A concentrated acid has a very high percentage of acid by weight/volume and very little water.

Crucial Difference: An acid can be strong but dilute (e.g., 0.1M HCl), and an acid can be weak but concentrated (e.g., glacial acetic acid, which is 100% acetic acid but only partially ionizes in water).

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4 Descriptive Questions

i. Explain Arrhenius concept of acids and bases.

Answer: The Arrhenius concept, proposed by Svante Arrhenius, defines acids and bases based on their behavior in aqueous solutions:

- **Arrhenius Acid:** A substance that produces hydrogen ions (H^+) when dissolved in water. For example:
 $\text{HCl(aq)} \rightarrow \text{H}^+(\text{aq}) + \text{Cl}^-(\text{aq})$.
- **Arrhenius Base:** A substance that produces hydroxide ions (OH^-) when dissolved in water. For example: $\text{NaOH(aq)} \rightarrow \text{Na}^+(\text{aq}) + \text{OH}^-(\text{aq})$.
- **Limitation:** This concept is limited to aqueous solutions only and cannot explain the acidic or basic behavior of substances in non-aqueous solvents or in the gas phase.

ii.

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

Answer:

- **Arrhenius Concept:** An acid produces H^+ ions in water; a base produces OH^- ions in water. It is restricted to aqueous solutions.
- **Bronsted-Lowry Concept:** An acid is a proton (H^+) donor; a base is a proton (H^+) acceptor. It is a broader concept and does not require water as a solvent.
- **Comparison/Example:** NH_3 is not an Arrhenius base because it doesn't contain OH^- . However, in the Bronsted-Lowry model, NH_3 is a base because it accepts a proton (H^+) from water to form NH_4^+ . Similarly, HCl is an acid in both models, but Bronsted-Lowry explains its reaction with NH_3 without needing water.

iii.

How does sulphuric acid react with the following compounds?

NH_4Cl , NH_4NO_3 , MgO , MgCO_3

Answer:

- **With NH_4Cl (Ammonium chloride):** H_2SO_4 reacts with ammonium salts to release ammonia gas (or form ammonium sulfate).



- **With NH_4NO_3 (Ammonium nitrate):** Forms ammonium sulfate and nitric acid.



- **With MgO (Magnesium oxide):** Being a basic oxide, it neutralizes the acid to form a salt and water.



- **With MgCO_3 (Magnesium carbonate):** A carbonate reaction producing salt, water, and carbon dioxide gas.



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

Answer: When a base reacts with a non-metallic oxide, it forms a salt and water. For example, when sodium hydroxide (a base) reacts with carbon dioxide (a non-metallic oxide), it forms sodium carbonate and water:



Inference: Since non-metallic oxides react with bases to form salts and water (a typical neutralization reaction), we infer that **non-metallic oxides are acidic in nature.**

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

(Clarification: The question likely intends to ask why dry HCl gas does NOT show acidic character, while the solution does. I will answer both).

Answer: Dry HCl gas does not show acidic character because it exists as a covalent molecule and does not contain free H^+ ions. Acids only show acidic properties in the presence of water. When HCl gas is dissolved in water, it ionizes completely to produce hydronium ions (H_3O^+) and chloride ions (Cl^-):



The presence of these free H_3O^+ ions is responsible for the acidic character of the HCl solution (and is why aqueous solutions of acids conduct electricity and turn blue litmus red).

vi.

Differentiate between an acid and its conjugate base.

Answer: An acid is a species that donates a proton (H^+), whereas its conjugate base is the species that remains after the acid has donated a proton. The difference between them is exactly one proton (H^+).

For example, in the reaction:



CH_3COOH is the acid, and CH_3COO^- is its conjugate base. The conjugate base has one less H^+ ion than the acid.

5 Investigative Questions

i.

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

Answer: Acids are indispensable for human survival and bodily functions:

- **Digestion:** Hydrochloric acid (HCl) in the stomach creates an acidic environment (pH ~1.5-3.5) necessary to activate digestive enzymes (like pepsin) and kill harmful ingested bacteria.
- **Metabolism:** Amino acids are the building blocks of proteins, and fatty acids are vital for energy storage and building cell membranes.
- **Genetic Material:** Phosphoric acid forms the backbone of DNA and RNA molecules.
- **Respiration:** Carbonic acid (H_2CO_3) is formed in the blood to transport carbon dioxide from tissues to the lungs.
- **Cellular Function:** Many enzymes function optimally only within specific pH ranges, maintained by acids and bases in the body.

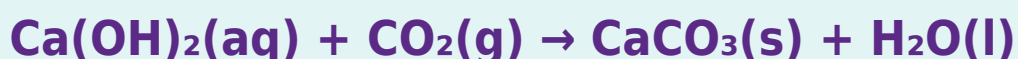
ii.

What is observed when CO₂ is passed through lime water (i) for a short duration (ii) for a long duration?

Answer:

(i) For a short duration: When carbon dioxide is passed through lime water (calcium hydroxide solution) for a short time, the solution turns **milky (cloudy)**. This is due to the formation of insoluble calcium carbonate.

Equation:



(ii) For a long duration: When CO₂ is passed continuously for a long time, the milky **disappears**. This is because the insoluble calcium carbonate reacts with excess CO₂ and water to form soluble calcium bicarbonate.

Equation:



EXERCISE COMPLETED ✓

Thank You!

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Chapter 07: Acid Base Chemistry.
Revise the concepts, practise the equations
and keep learning with us!

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