Q.1 Explain the interrelationship between acids, bases, and salts.

Answer:
Acids and bases are chemical opposites. When they react, they undergo neutralization to form salts and water.

- Acids provide H^+ ions; bases provide OH^- ions.
- Their combination removes these ions, forming neutral water and a salt.
  This interrelationship is essential in titration experiments, agriculture (soil treatment), medicine (antacids), and daily products like toothpaste. Understanding this balance is key to controlling pH and ensuring safe chemical reactions in real-world scenarios.

Q.2 What is the role of salts in maintaining body functions?

Answer:
Salts, especially electrolytes like NaCl, KCl, and $CaCl_2$, help regulate fluid balance, nerve impulses, and muscle function in the body.
Sodium and potassium maintain osmotic balance and blood pressure. Calcium salts support bone strength and muscle contraction.
Electrolytes are lost during sweating, and deficiency can lead to fatigue, cramps, or dizziness. Therefore, salt intake through food or oral rehydration solutions is critical for maintaining health and biochemical functions.

Q.3 How do indicators help in identifying acids and bases?

Answer:
Indicators are substances that change color in the presence of acids or bases. They help identify the nature of a solution:

- Litmus: blue in base, red in acid
- Phenolphthalein: colorless in acid, pink in base
- Methyl orange: red in acid, yellow in base
  Indicators are crucial in titration experiments to determine unknown pH or concentration. They are also used in soil testing kits, aquarium maintenance, and chemical safety checks.

Q.4 Describe the preparation of washing soda from baking soda.

Answer:

Washing soda ($Na_2CO_3 \cdot 10H_2O$) is prepared from baking soda ($NaHCO_3$) through a two-step process:

1. Thermal decomposition:
   $2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$

2. Rehydration:
   The resulting anhydrous Na_2CO_3 is dissolved in water and recrystallized to form washing soda crystals with 10 water molecules.
   Washing soda is a strong base used in laundry, water softening, and cleaning agents.

Q.5 Define anhydrous salts. How are they prepared?

Answer:

Anhydrous salts are salts that do not contain water of crystallization. They are usually prepared by heating hydrated salts to remove the chemically bound water.

For example:

$CuSO_4 \cdot 5H_2O$ (blue) $\rightarrow$ $CuSO_4$ (white) + $5H_2O$ (on heating)

Anhydrous salts are hygroscopic, meaning they absorb moisture from the air, making them useful as drying agents in laboratories (e.g., anhydrous calcium chloride). Their ability to absorb moisture is used in packaging, gas drying, and chemical analysis.

Q.6 Explain how the pH scale is connected to the strength of acids and bases, and how this relates to the formation of different types of salts in neutralization reactions.

Answer:

The pH scale measures the concentration of hydrogen ions (H^+) in a solution, ranging from 0 (strongly acidic) to 14 (strongly basic). Strong acids like HCl dissociate completely, producing low pH values, whereas weak acids like acetic acid only partially ionize. When acids and bases react, neutralization occurs, forming salt and water. The nature of the salt depends on the strengths of the acid and base involved. For instance, strong acid + strong base forms a neutral salt (NaCl), while weak acid + strong base forms a basic salt (CH_3COONa). Thus, pH directly relates to both strength and salt type.

Q.7 How does the concept of water of crystallization in hydrated salts link to the physical appearance and chemical behavior of acids, bases, and salts? Support with an example.

Answer:

Water of crystallization refers to the fixed number of water molecules incorporated into the crystal structure of certain salts. This water affects the physical appearance (e.g., color, texture) and chemical behavior of the salt. For instance, copper(II) sulfate pentahydrate ($CuSO_4 \cdot 5H_2O$), which forms when copper oxide reacts with sulfuric acid, is blue due to the presence of water. Upon heating, it loses its water of crystallization and turns white (anhydrous). This shows how neutralization between acids and bases not only forms salts but also influences their hydration states, affecting solubility, thermal behavior, and even identification in practical chemistry.

Q.8 Analyze the role of acidic and basic oxides in the environment and explain how their reaction with water and pH influences salt formation and environmental issues like acid rain.

Answer:

Acidic oxides such as SO_2 and NO_2, released from vehicle exhausts and industries, react with atmospheric water to form acids like H_2SO_4 and HNO_3, leading to acid rain. This lowers the pH of soil and water bodies, harming ecosystems. These acids react with basic oxides or carbonates in the environment, forming salts such as calcium sulfate or nitrate. Conversely, basic oxides like CaO can neutralize acidic soils, forming neutral or basic salts. These interactions show how oxide reactions affect pH and salt formation, and highlight environmental issues like acidification, deterioration of monuments, and soil chemistry changes due to acid rain.

Q.9 How does the difference in physical properties of hydrated and anhydrous salts influence their use in everyday applications like heating packs or desiccants?

Answer:

Hydrated and anhydrous salts differ significantly in physical and chemical properties. Anhydrous salts, like anhydrous calcium chloride ($CaCl_2$), are hygroscopic and absorb moisture, making them ideal desiccants. Hydrated salts, such as sodium thiosulfate pentahydrate, can undergo exothermic dehydration, useful in heating packs. Cobalt chloride

($CoCl_2$) serves as a moisture indicator—blue when anhydrous, pink when hydrated. The ability to absorb or release water allows these salts to function in moisture control, heating, and chemical storage. These applications highlight how the state of hydration affects behavior and how crystallization concepts connect with real-world uses of salt chemistry.

Q.10 A student heated a hydrated salt and observed a color change and mass loss. What does this tell you about water of crystallization and the chemical stability of the salt?

Answer:

When a hydrated salt is heated, water of crystallization is released, often causing a visible color change and reduction in mass. For example, heating blue $CuSO_4 \cdot 5H_2O$ yields white anhydrous $CuSO_4$ and water vapor. The color change indicates dehydration, while mass loss confirms water release. This reaction demonstrates that water of crystallization is loosely bound and can be removed without decomposing the salt's basic structure. It highlights the importance of proper drying in experiments like titrations. This process illustrates how physical and chemical properties of salts are influenced by hydration, and how stability can be tested through controlled heating.