

Acid - GCSE Chemistry

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1. Introduction

Acid

- Those substances that release H^+ ion in any solution
- Acids taste sour and can corrode metals
- Common Examples: Citric acid present in Lemons, Vinegar
- Their pH value lies within 0 to 7

Base

- Those substance which donate OH^- ions in solution are called Bases. Bases are also called Alkalis when dissolved in water.
- They taste bitter
- Common Examples: Sodium hydroxide, Ammonia, Baking soda
- Their pH value lies within 8 to 14

★ The pH scale is used to detect whether the solution is acidic or basic.



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2. What are Acids and Base?

ACIDS : An Acid is a substance that releases H^+ ions in water. Acids usually have sour taste and can turn blue litmus paper into red.

Examples:



Hydrochloric Acid
 HCl



Acetic Acid
 CH_3COOH



Sulphuric Acid
 (H_2SO_4)



Carbonic Acid



Citric Acid



Salicylic acid

Base: A base is a substance that releases OH^- (hydroxide) ions in water. Bases usually have a bitter taste, feel soapy, and turn red litmus paper blue.

Examples:



Sodium Hydroxide



Calcium Hydroxide



Potassium
Hydroxide



Magnesium
Hydroxide

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Uses of Acids :

- The **carbonic acid** gives fizz to soda drinks.
- **Acetic acid(vinegar)** is used for pickling.
- **HCl** is used for **concrete cleaning** and for **pool PH adjustment**.
- Acids are also used in **batteries and metal works**.

Uses of Bases :

- The soap and detergent products contain Sodium hydroxide(base).
- Ammonia is common household cleaner and fertilizer raw material.
- Calcium Hydroxide(slaked lime) is used to soften water, to deal with acidic soil and is used in cement.

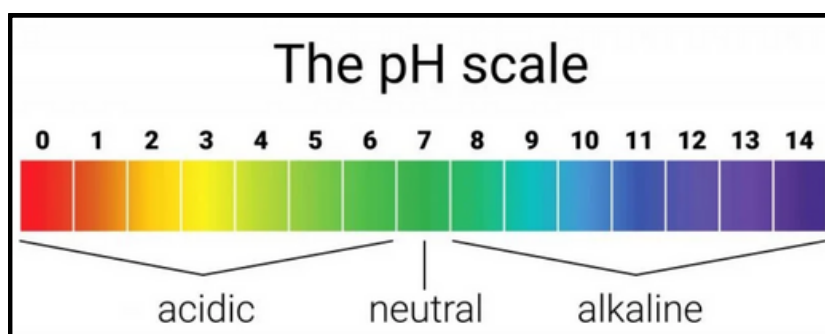
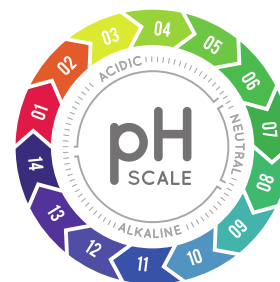
3. What is pH Scale and How it is measured?

pH Scale is a numerical scale that is used to measure how acidic or basic a substance is. This scale's value ranged from 0 to 14-

pH = 7 Neutral (Pure Water)

pH > 7 Basic (Baking Soda, Soap)

pH < 7 Acidic (Lemon Juice, Vinegar)



- **Fact:** Bee stings are acidic and has pH between 5 and 5.5

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Formula to find the pH of any solution -

The pH of any substance is a measure of how much acidic or a basic that substance is. The formula to measure pH is -

$$\text{pH} = -\log_{10}[\text{H}^+]$$

Where, $[\text{H}^+]$ is the concentration of Hydrogen ions in (Moles per Liter or M)

Steps to calculate Ph -

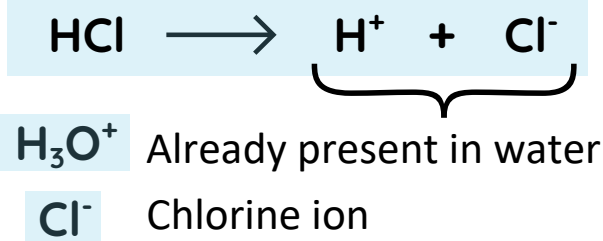
- Find the H^+ concentration, for strong acids like HCl (Hydrochloric acid). The concentration of acid equals the concentration of H^+ ions.
- For weak acids and bases you may need to use an equilibrium expression or the **K_a** (Acid Dissociation constant).

Example:

Calculating pH values -

- HCl** (Hydrochloric Acid) is a **strong acid**(dissolves completely)

Dissociation
Reaction



- This reaction is responsible for the acidic nature of Hydrochloric Acid

$$[\text{H}^+] = [\text{HCl}]$$

The concentration of Hydrogen ions is same as the concentration of Hydrochloric acid.

- If $[\text{HCl}] = 0.001\text{M}$

$$\text{pH} = -\log[0.001]$$

$$\text{pH} = -\log[10^{-3}]$$

$$\text{pH} = 3$$

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4. Concept of Dilute and Concentrated Solution

Dilute Solution:

A Dilute has small amount of solute dissolved in large amount of solvent.



Example:

Salt water with small amount of salt,
Sugar water with a few tea spoons
of sugar.

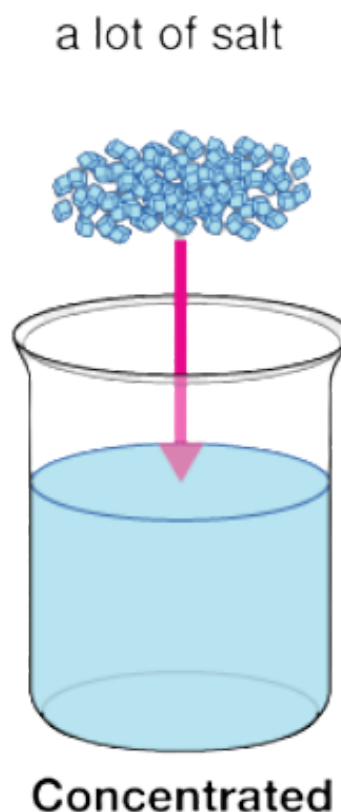
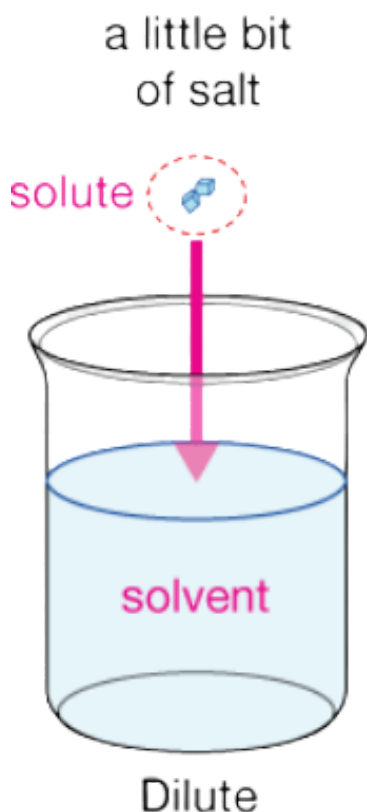
Concentrated Solution:

A Concentrated Solution has large
amount of solute dissolved in small
amount of solvent.



Example:

Syrup, Battery acid.



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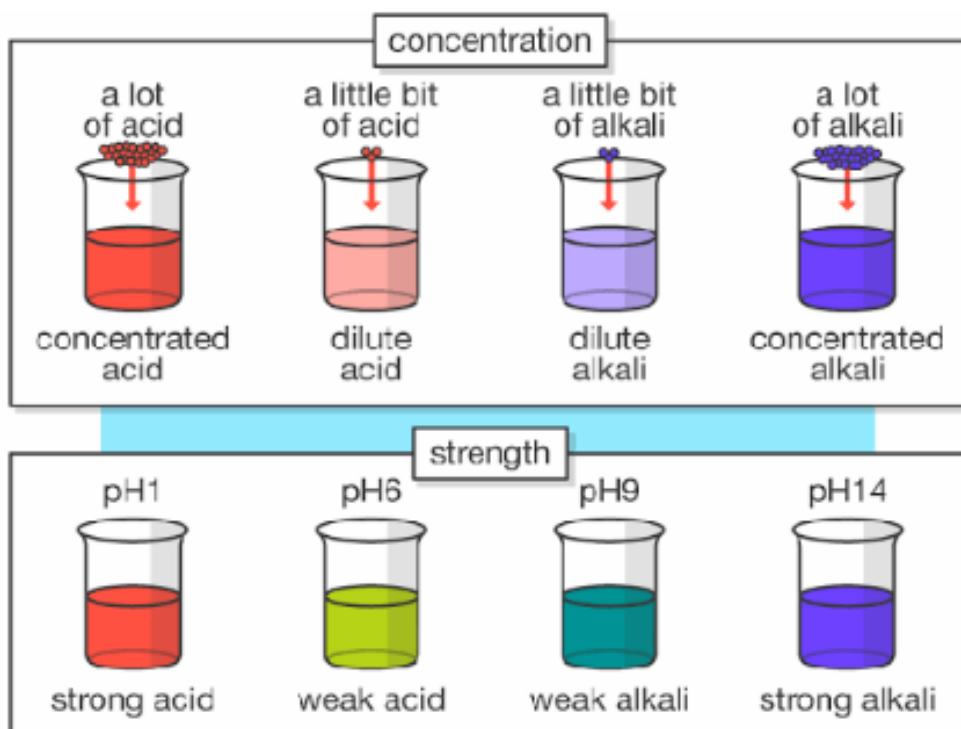
Dilute or Concentrated $\neq$ Acidic or Basic

The terms Dilute and Concentrated describe the amount of solute dissolved in a given quantity of solvent, not the chemical strength or nature of the solute.

In brief: A Small amount of solute in a large amount of solvent.

Concentrated Solution: A Large amount of solute in a smaller amount of solvent.

These terms tell us how much solute is present, but not how weak or strong the solute is in terms of chemical behaviour.



Examples to clarify -

- **Dilute Acid:** Small amount of Hydrochloric acid in large amount of water. Still an acid but weak and not dangerous.
- **Concentrated Acid:** A large amount of HCl in little amount of water. Still an acid but stronger and much corrosive.
- **Dilute Base:** A small amount of Sodium Hydroxide(NaOH) in water. Still a base but mild.

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5. Examples of Acid and Base Reaction

- The **reaction between Acid and base** is called **Neutralisation reaction**. Often when an acid and base react **salt and water is formed**.

Examples -

- Hydrogen Bromide reacts with Potassium Hydroxide to form water and Potassium Bromide. Potassium Bromide is formed from the K^+ ions from the base(KOH) and OH^- ions from the acid HBr.



- Hydrochloric acid reacts with Ammonia to form Ammonium Chloride(salt). Ammonium Chloride is made up of NH_4^+ cations from the base NH_3 and Cl^- anions from the acid HCl.



Some Uses of Acid Base reactions -



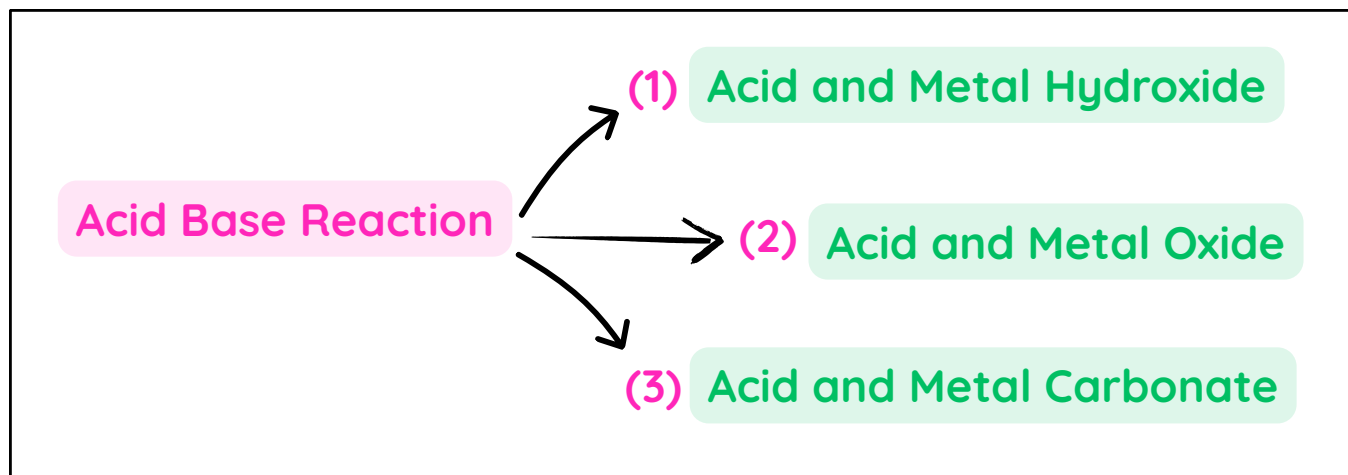
Calcium Oxide is used on Acidic soil, to raise the pH and make the soil suitable for plant growth.



Antacids are used when a person feels pain in stomach due to too much acid and digestion issue. Examples include Magnesium Hydroxide, Aluminium Hydroxide etc.

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Let us discuss some specific types of Acid Base reaction in which type of base used changes and acid remains the same -



(1) Acid and Metal Hydroxide :

When an **Acid** reacts with metal hydroxide, a salt and water are formed. These are a type of **double displacement reactions**.

Examples -

- Hydrochloric acid reacts with Sodium Hydroxide to form Water and Sodium Chloride.



- Here, Hydrochloric Acid reacts with Aluminium Hydroxide to form Water and Aluminium Chloride.



Properties -

- It is an **Exothermic reaction**.
- The reaction **do not produce any gas**.
- Both soluble and insoluble metal hydroxides can react with acids.

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(2) Acid and Metal oxide :

When an Acid reacts with metal oxide, a salt and water are formed.

Examples -

- Reaction of Hydrogen Bromide and Magnesium oxide gives us Water and Magnesium Bromide.



- Hydrochloric Acid reacts with Aluminium Oxide and forms Water and Aluminium Chloride.



Properties -

- It is an **Exothermic** reaction.
- The reaction **do not produce any gas**.

(3) Acid and Metal Carbonates :

When an Acid reacts with metal carbonate, Carbon Dioxide and Water are formed.

Examples -

- Nitric Acid reacts with Sodium Carbonate and forms Nitrate, Carbon dioxide and water.



- Sulfuric acid reacts with Sodium carbonate to form Nitrate, Carbon dioxide and water.



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Properties -

- The reaction is **mildly Exothermic**.
- In the reaction of acid and carbonates the **CO₂ gas is produced**. The gas can be tested by passing it through limewater which turns milky/cloudy if there is CO₂.

6. Formation of Water from its ions

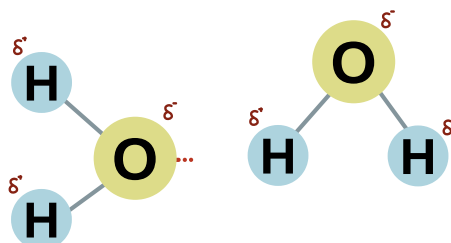
We know that Water(a compound) consists of two elements, Hydrogen and Oxygen (constituents).



2H₂ : Hydrogen molecule

O₂ : Oxygen molecule

2H₂O : Water molecule



Activation Energy : The energy required to reach at the stage of breaking bonds within Hydrogen and Oxygen Molecules.

Bond breaking : The energy required to break the bonds present in reactants.

Bond formation : Formation of new bonds between Hydrogen and oxygen.

Energy Release : Energy is released in the form of Water and Light, and that is why Hydrogen is used as fuel in rocket

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7. FAQ's

(1) How Acids and Bases are different from each other?

Answer: Acids donate H^+ ions on the other hand bases donate OH^- ions when dissolved in a solution.

(2) What is Neutralisation reaction?

Answer: It is the reaction of Acid and Base and is called neutralisation reaction as the ions from acid and base combine and form water.

(3) What is the importance of PH in everyday life?

Answer: Maintaining the PH level is crucial for proper functioning of many systems in our everyday life including human body.

(4) What is the formula to find the PH of any solution?

Answer: $\text{pH} = -\log_{10}[\text{H}^+]$

(5) Write about what the concept of Dilute and Concentrated solution tells us ?

Answer: The concept of dilute and concentrated solution tells us how much strong an acidic or basic solution is.