

Acids and Bases

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- ▶ Acids and bases can be defined in terms of the ions they produce in solution.
 - I. **Acids:** Substances that will produce **hydrogen** (H^+) **ions** in aqueous solutions.
 - II. **Bases:** Substances that will produce **hydroxide** (OH^-) **ions** in aqueous solutions.
- ▶ **Alkali.** Alkali are bases that are **soluble**. When a soluble base is dissolved, the resulting solution is referred to as being **alkaline**.
- ▶ The **more** H^+ **ions** that a substance produces in solution, the **more acidic** the substance.
- ▶ The **more** OH^- **ions** a substance produces, the **more basic** (or alkaline) it is.
- ▶ **Examples:** Common acidic substances include vinegar, citric acid, and even milk (though only very mildly in the last instance). Bases are much more commonly found in cleaning supplies, for example bleach and ammonia are both strongly basic compounds.

The pH Scale:

- ▶ The **pH Scale** is the most commonly used method to measure the acidity or basicity of a substance.
- ▶ The scale is a measure of the amount of H^+ ions that a substance will produce in solution (i.e. the concentration of H^+ ions, represented by $[H^+]$).
- ▶ The **lower** the value of its pH, the higher the **concentration** of H^+ **ions**.
- ▶ pH scale tell us the nature of the solution either it's
 - I. Natural
 - II. Acidic
 - III. Basic

1. Natural pH:

- ▶ The values of pH range from **0 to 14** and have no units. Substances with a **pH of 7** are said to be **neutral**

2. Acidic pH

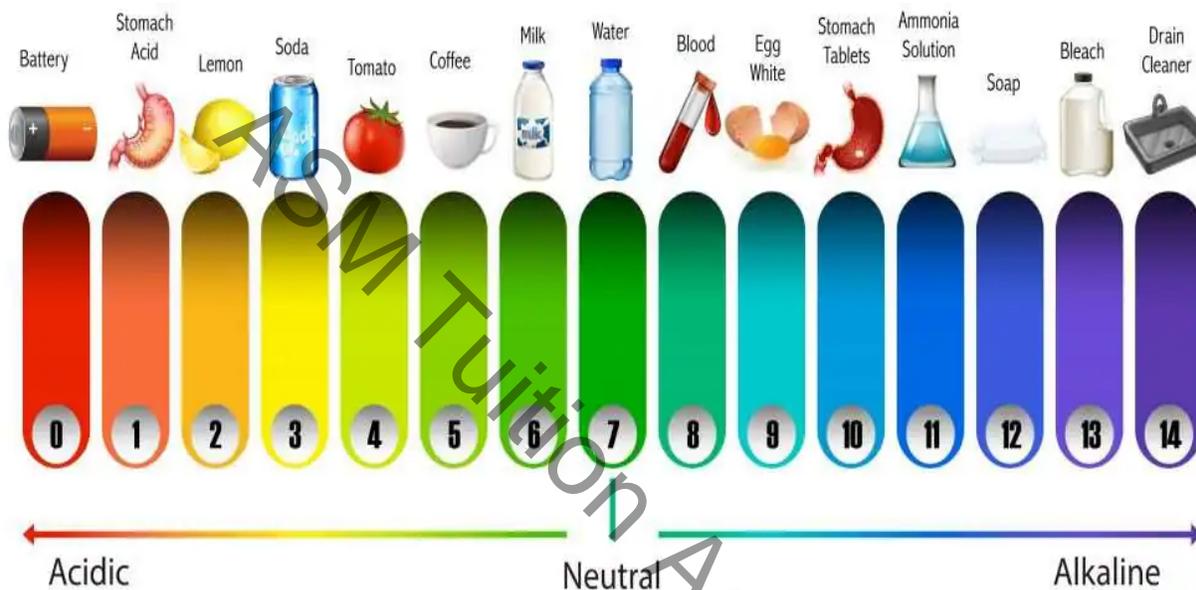
- ▶ The **lower** the pH then the **more acidic** the solution is
- ▶ Chemicals with pH values that fall within the range **0 to 6 are known as acidic**.

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- This includes chemicals such as **battery acid (pH 0)** and **milk (pH 6)**. As the pH of a substance **decreases**, its **acidity increases**.

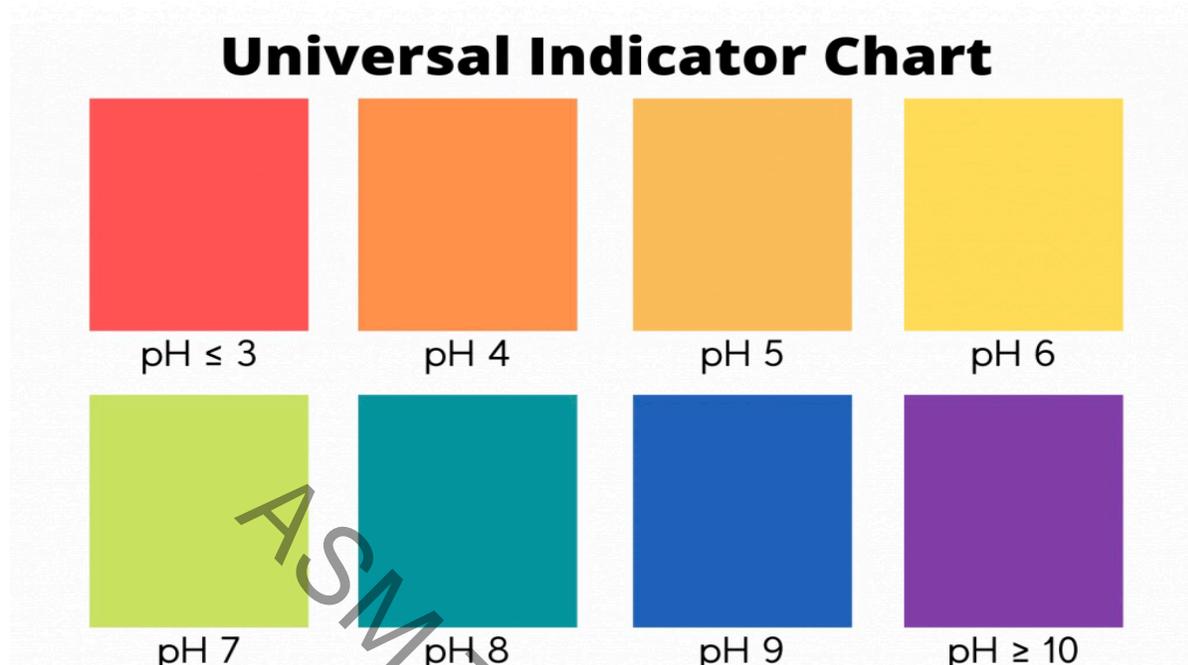
3. Basic pH

- The **higher** the pH then the **more alkaline** the solution is
- Chemicals with pH values that fall within the range **8 to 14 are known as basic (or alkaline)**.
- This includes chemicals such as **ammonia (pH 11)** and **blood (pH 8)**.
- As the pH of a substance **increases**, its **basicity increases**.



Universal indicator

- Universal indicator is an acid-alkali indicator that gives a more precise measurement of pH.
- It produces a range of colours that can be compared to a colour chart to determine the pH of a solution.
 1. On the left side of the scale, below pH 7, are acidic solutions. These solutions will range in colour from dark red (strong acid) to yellow (weak acid).
 2. In the middle, at pH 7, you get neutral solutions, which is indicated by a colour change to green. This is where you find pure water.
 3. On the right side of the scale, above pH 7, are alkaline solutions. These solutions will range in colour from dark green (weak alkali) to purple (strong alkali).



- ▶ When performing acid-base reactions, we can use universal indicators to determine when the reaction has reached a neutral state. If neutralisation has occurred, the solution should change to a green colour.”

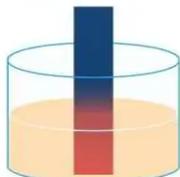
Litmus paper

- ▶ **Litmus paper** is a strip of paper that has been treated with a mixture of dyes. There are two types of litmus paper:
 1. Blue litmus paper – This turns red in acidic solutions
 2. Red litmus paper – This turns blue in alkaline solutions
- ▶ Litmus paper is a quick and easy way to test the pH of a solution, but it is not as precise as universal indicator.

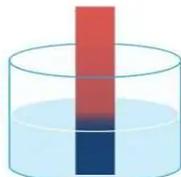
Litmus paper is usually RED or BLUE



Litmus test



Acidic solution turns BLUE litmus paper to RED colour



Alkaline solution turns RED litmus paper to BLUE colour



Benefit

- Quick and simple method



Limitation

- Cannot give an exact measure of pH value
- Other substances in the solution can interfere with the colour change of the litmus paper

pH meter

- A **pH meter** is a more precise and accurate way to determine the acidity or basicity of a solution compared to using a universal indicator.
- When placed in a solution, the pH meter provides a numerical value indicating the solution's acidity or basicity.
- For example, if the reading is 2, the solution is acidic. The numerical data provided by the pH meter is more accurate than the colour-based method of using a universal indicator.



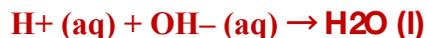
Acids and bases Neutralise each other

- ▶ **Neutralisation** happens when an acid and a base react with each other. Typically, in aqueous acid-base reactions, this results in the formation of water and a salt.
- ▶ Remember that:
 1. Acids in solution release hydrogen ions (H⁺)
 2. Alkalis in solution release hydroxide ions (OH⁻)
- ▶ Essentially, neutralisation involves the combination of these hydrogen ions and hydroxide ions to form neutral water molecules. During this process, a salt is also produced.
- ▶ **Example of a Neutralisation Reaction**

When hydrochloric acid reacts with sodium hydroxide in solution, the following reaction occurs:



- This reaction forms water and sodium chloride, a salt.
- ▶ Because both reactants are in an aqueous solution, we can also represent this equation using the ions involved in the reaction:
$$\text{H}^+ \text{ (aq)} + \text{Cl}^- \text{ (aq)} + \text{Na}^+ \text{ (aq)} + \text{OH}^- \text{ (aq)} \rightarrow \text{Na}^+ \text{ (aq)} + \text{Cl}^- \text{ (aq)} + \text{H}_2\text{O (l)}$$
- ▶ Some ions, such as Na⁺ and Cl⁻, appear on both sides of the equation. These ions don't change or react further once in solution and are known as spectator ions. We can remove them from the equation to focus on just the neutralisation reaction:



- ▶ Since water is a neutral substance (pH = 7), this reaction removes any acidic or alkaline properties of the reactants, which is why it is called a neutralisation reaction.