12. Introduction to Acid & Base

Can you tell?

1. We consume many food items in our daily life e.g. lemon, tamarind, tomato, sugar, vinegar, salt etc. Do all items taste similar?
2. Write the taste of lemon, sugar, curd, lime, baking soda, amla, tamarind, raw mango, pomegranate, water (sour, astringent, sweet, bitter, tasteless)

Acid

You will notice that some substances have sweet taste, some are bitter, some are sour or astringent. Lemon, tamarind, vinegar or amla like substances acquire sour taste due to the presence of a typical compound in them. Such compounds imparting sour taste are called acids. Acids are soluble in water and they are corrosive in nature. Animals and plants also possess acids in them.

Acids present in food stuffs are called natural acids or organic acids. These acids being weak in nature are called weak acids. Some acids are strong in nature. They are caustic/inflammatory, e.g. sulphuric acid (H_2SO_4), hydrochloric acid (HCl) and nitric acid (HNO_3). These acids are also called 'mineral acids'. The skin gets burnt when their concentrated solution falls on skin, similarly their vapours if inhaled can be harmful to health. Strong concentrated acids are converted into their dilute acids by slowly adding them into water. Such dilute acids are less harmful than their corresponding strong acids.

If you taste dilute solution of baking soda, you will find it astringent/bitter. Substances having astringent/bitter taste and slippery to touch e.g. Lime water [$(CaOH)_2$], baking soda ($NaHCO_3$) caustic soda (NaOH) and soap are called bases. Bases are completely different from acids. Chemically they have properties opposite to that of acids. They are also inflammatory to skin in their concentrated form. We know that the distilled water is tasteless. Water is neither acidic nor basic.

Indicator :

The substances which are neither acidic nor basic and are chemically inert in nature. Touching or tasting of acid or base is very harmful and hence typical indicators are used to recognise them. The substances which change their colours in presence of acid or base are called 'Indicators'.

Indicators in Laboratory :

In the laboratory, litmus paper is mainly used to test alkali or base. This paper is made by an extract of licane plant. It is red or blue coloured. Blue litmus paper turns red on dipping in acid and red litmus turns blue by alkali. Similarly phenolphthalein, methyl orange and methyl red are used in laboratory in solution form. Methyl orange indicator becomes pink in acid and yellow in alkali. Phenolphthalein remains colourless in acid and becomes pink in alkali. Universal indicator which are in liquid state change their colour in the presence of acid and base.

Methyl orange

Phenolphthalein

Methyl red

Litmus papers

12.1 Laboratory indicators

Sr.No.	Name of Indicator	Colour of the Indicator	Colour in Acid	Colour in alkali
1	Litmus paper	Blue	Red	Blue (Remain same)
2	Litmus paper	Red	Red (Remain same)	Blue
3	Methyl orange	Orange	Pink	Yellow
4	Phenolphthalein	Colourless	Colourless	Pink
5	Methyl red	Red	Red	Yellow

12.2 : Indicators and their colours in acid and base

Domestic Indicator : On non availability of laboratory indicator, 'natural indicators' can be made by using several domestic substances. You must have seen yellow food stain turning red after washing with soap. This colour change is a result of chemical reaction between turmeric and alkaline mateiral of soap. Here turmeric acts as on indicator. Natural indicators can also be prepared from red cabbage, radish, tomato and similarly from hibiscus and rose.

Making of natural indicator :

Try this

Apparatus : Hibiscus, rose, turmeric, red cabbage leaves, filter paper etc.

Activity : Rub red petals of hibiscus flower on the white filter paper, This gives hibiscus indicator paper. Similarly rub, rose petals on the white filter paper. Cut strips of this paper, it is a rose indicator paper. Take turmeric powder, add little water in it. Dip filter paper or ordinary paper in the turmeric water for some time. After drying make strips of that paper. Prepare turmeric indicator paper in this way. Put leaves of red cabbage in small quantity of water and heat it. Once solution of cabbage leaves cool down, dip papers in it and dry it. Make strips of dried paper. In this way prepare red cabbage indicator paper.

Put some drops of following substances on the indicator papers prepared by the above method and write the effect in the following table.

Sr.No.	Substance	Effect on turmeric paper	Acidic / basic
1	Lime juice		
2	Lime water (calcium hydroxide)		
3	.....		

Try this

Take baking powder. Add little water to it. Add this solution on to lime juice, vinegar, orange juice, apple juice, etc. and note the findings.

What do you observe on addition of baking soda solution in the fruit juice? Whether bubbles formed or effervescence came out of fruit juice?

From the above first activity we came to know that turmeric indicator paper's turns red yellow colour in certain solutions. Similarly on addition of baking soda solution in the acidic solution bubbles come out or effervescence is produced.

By these simple and easy activity we can identify acidic or alkaline substance.

Try this

Under the guidance of teacher take vinegar, lime juice, ammonium hydroxide (NH_4OH) and dil. hydrochloric acid (HCl) in different test-tubes. Add drops of following indicators in them. Also dip litmus papers in the solutions. Observe and record in the following table.

Sample solution	Red litmus	Blue litmus	Phenolphthalein	Methyl orange	nature of solution (Acidic/Basic)
Lime juice					
NH_4OH					
HCl					
Vinegar					

12.3 Effect of acid and base on litmus paper

From above experiments it is seen that blue litmus turns red in acids and red litmus turns blue in alkali. Orange colour of methyl orange turns pink in acid while colourless phenolphthalein turns pink in alkali solution.

Can you tell?

1. What happens when sour substances like lime juice, tamarind water falls on shahabad stones or kitchen platform? Why?
2. Collect soil samples from your surroundings and find out whether it is acidic, alkaline or neutral?
3. Which substances are used to clean greenish stains on copper vessels and to shine blackish silver utensils?
4. Why tooth-paste is used for brushing teeth?

Acid

Acid is such a substance which gives H^+ ions in solution state. e.g. HCl dissociates in water solution.

$$HCl\ (aq) \longrightarrow H^+ + Cl^-$$

(Hydrochloric acid) (Hydrogen ion) (Chloride ion)

Examples of some acids : Hydrochloric acid (HCl), Nitric acid (HNO_3), Sulphuric acid (H_2SO_4), Carbonic acid (H_2CO_3) (in cold aerated drinks), ascorbic acid, citric acid in lemon and other fruits, acetic acid in vinegar, etc.

Our daily diet contains a few natural (organic) acids. They are mild in nature and hence are not harmful like mineral acids.

Sr. No.	Substance / Source	Acids (Natural/organic)
1	Vinegar	Acetic acid
2	Orange	Ascorbic acid
3	Tamarind	Tartaric acid
4	Tomato	Oxalic acid
5	Curd	Lactic acid
6	Lemon	Citric acid

12.4 Natural acids

Properties of acid :

1. Acids are sour in taste.
2. Acid molecules contain hydrogen ion (H^+) as a main costituent.
3. Acid reacts with metal to form hydrogen gas.
4. Acid reacts with carbonates and liberates CO_2 gas.
5. Blue litmus turns red in acid.

Use of acids

1. Acids are used in the production of chemical fertilizers.
2. Acids are used in the production of explosives, oil purification, medicines, dyes and paints.
3. Hydrochloric acid is used for the preparation of different types of chloride salts.
4. Dil. H_2SO_4 acid is used in the batteries. (electric cell)
5. Dil. HCl is used for sterilization of water.
6. Acid is used for making of white paper from wood pulp.

Causticity of concentrated acid and base : Dissolution of conc. H_2SO_4 in water generates large amout of heat. Therefore for dilution of concentrated acid, it is slowly added to water. Never add water in the concentrated sulphuric acid. It will produce enormous heat and cause explosion.

Bases like sodium hydroxide and potassium hydroxide are strong and caustic in nature. Their concentrated solution burns skin as it decomposes the proteins in skin.

Use your brain power

The iron knife shines better after cutting the sour fruits like lemon, raw mangoes. Why?

- We have seen that mineral acids are harmful to body. However serveral organic acids are present in our body and in plants which are useful to us.
- DNA (Deoxyribo Nucleic Acid) is an acid present in our body decides heredity property.
- Proteins which are part of our body cell are made up of amino acids.
- Fat of our body is formed by fatty acids.

Base

Base is a substance whose water solution gives hydroxide (OH^-) ion e.g.

$NaOH\ (aq) \longrightarrow Na^+(aq) + OH^-\ (aq)$

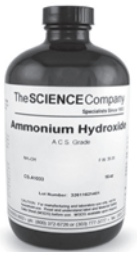
(Sodium Hydroxide) (Sodium ion) (Hydroxide ion)

Sodium Hydoxide

Potassium Hydroxide

Calcium Hydroxide

Magnesium Hydroxide



Ammonium Hydroxide

12.5 Some examples of Base

Sr.No.	Name of Base	Formula	Use
1	Sodium hydroxide/Caustic soda	NaOH	Washing soap
2	Potassium hydroxide / Potash	KOH	Soap//shampoo
3	Calcium hydroxide/lime water	$Ca(OH)_2$	lime/white washing
4	Magnesium hydroxide / milk of magnesia	$Mg(OH)_2$	Acidity resistant medicines (Antacids)
5	Ammonium hydroxide	NH_4OH	for production of fertilizers

12.6 Table : Formulae of bases and their uses.

Always remember

Remember for identification of any substance it is dangerous to taste, inhale or touch them.

Properties of alkalies :

1. Bases has bitter taste.
2. They are slippery.
3. Bases contains hydroxide (OH^-) as a main constituent.
4. Metal oxides are generally basic in nature.

Neutralization

We have seen that acid contains (H^+) hydrogen ions and base contains(OH^-) hydroxide ions. Salt and water are formed by combination of acid and base.

Acid + Base $\longrightarrow$ Salt + Water

$HCl + NaOH \longrightarrow NaCl + H_2O$

(Hydrochloric acid) (Sodium hydroxide) (Sodium chloride) (Water)

This chemical reaction is called neutralization.

Do you know?

Hydrochloric acid is present in our stomach. It helps to ease digestion process. However excessive acid leads to indigestion. Antacids are used to control this hyper acidity. This medicine contains milk of magnesia [$Mg(OH)_2$]. Such alkaline medicine neutralises excess acid present in stomach.

The acidity of soil increases due to excessive use of chemical fertilizers. Under the guidance of agriculturist lime stone or lime water is mixed in the acidic soil. Such alkaline substances neutralizes excess acid present in the soil.

Exercises

1. Identify the following solutions, whether they are acid or base.

Solution	Change in Indicator			Acid / Base
	Litmus	Phenolphthalein	Methyl orange	
1.	--	No change	--	
2.	--	--	Orange colour turns red	
3.	Red litmus turns blue	--	--	

2. Write chemical names from given formulae.

H_2SO_4, $Ca(OH)_2$, HCl, NaOH, KOH, NH_4OH

3. Sulphuric acid has highest importance in chemical Industry. Why?

4. Give answers.

a. Which acid is used for getting chloride salt?

b. By squizzing lemon on a piece of rock the gas liberated turned lime water milky. which compound is present in the rock?

c. The label on the bottle of chemical is spoiled. How will you find whether the chemical is acidic or not?

5. Answer the following questions.

a. Explain the difference between acid and base.

b. Why indicator does not get affected by salt?

c. Which substances are produced by neutralization process ?

d. Which are the industrial uses of acids?

6. Select proper word given in bracket and fill in the blanks.

a. Main constituent of acid is.....

b. Main constituent of base is.....

c. Tartaric acid is a ..... acid.

7. Match the pairs.

Group A	Group B
1. Tamarind	a. Acetic acid
2. Curd	b. Citric acid
3. Lemon	c. Tartaric acid
4. Vinegar	d. Lactic acid

8. State true or false.

a. Oxides of metals are acidic in nature.

b. Table salt is acidic.

c. Metal corrodes due to salts

d. Salts are neutral.

9. Classify following substances into acidic, basic and neutral group -

HCl, NaCl, MgO, KCl, CaO, H_2SO_4, HNO_3, H_2O, Na_2CO_3

Project :

Write in your own language the uses and importance of neutralization reaction in daily life.

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