

Name of the student: *Date:* 30/09/2020

Indicators:

The materials which identify whether a substance is an acid or a base or none of these are called indicators.

- Litmus paper, Methyl orange, Phenolphthalein, Methyl red all are indicators.
- A universal indicator is a mixture of indicators which give a gradual change in color over a wide pH range.
- "Universal indicator" contains thymol blue, methyl red, bromothymol blue, thymol blue, and phenolphthalein.
- "Universal indicator" covers a pH range from less than 3 (red) to greater than 11 (violet). Intermediate colors include orange/yellow (pH 3 to 6), green (pH 7 or neutral), and blue (pH 8 to 11).

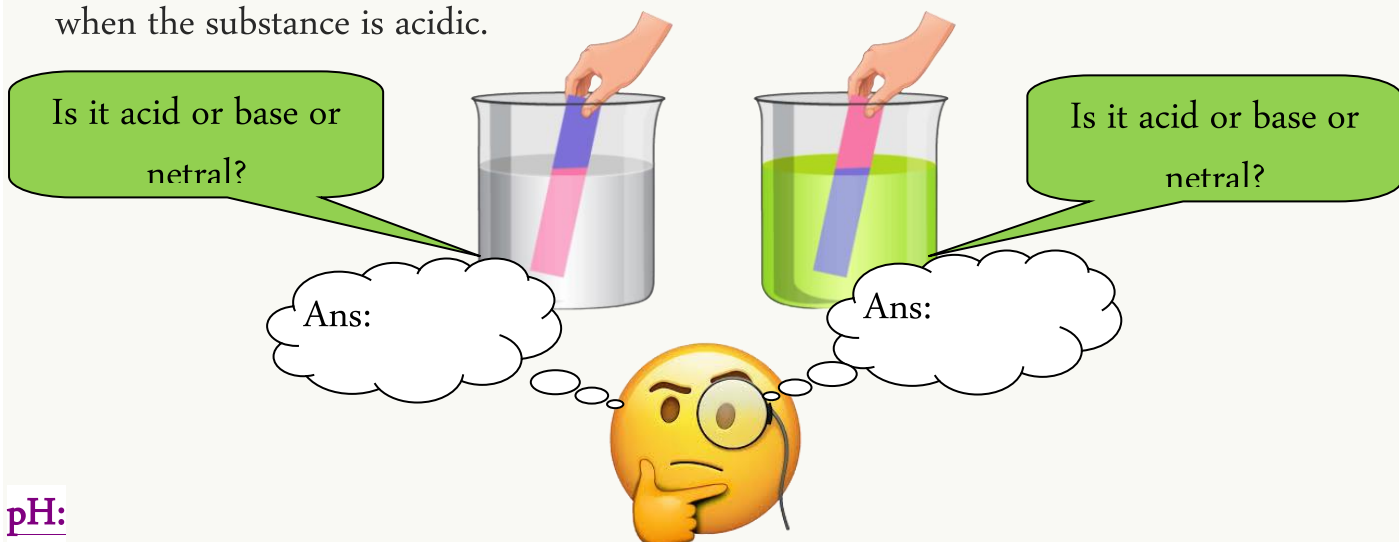
Indicator	Color		P ^H Range
	Acid	Base	
Methyl Orange	Red	Yellow	3.2-4.4
Methyl Red	Yellow	Red	4.8-6.0
Phenolphthalein	Colorless	Magenta	8.2-10.0
Bromocresol Green	Yellow	Blue	3.8-5.4
Bromothymol Blue	Yellow	Blue	6.0-7.6
Phenol Red	Yellow	Red	6.8-8.4
Thymol Blue (1 st Change)	Red	Yellow	1.2-2.8
Thymol Blue (2 nd Change)	Yellow	Blue	8.0-9.6

Litmus Paper:

Litmus paper is a type of pH paper which is prepared from ordinary paper by using the colour from the leaves of a tree called Lichens.

- The first known use of litmus was around 1300 CE by Spanish alchemist Arnaldus de Villa Nova. The blue dye has been extracted from lichens since the 16th century. The word "litmus" comes from the old Norse (Norwegian) word from "dye" or "color."
- Usually, litmus paper is either red or blue.

- Red paper turns blue when the substance is basic or alkaline, while blue paper turns red when the substance is acidic.



pH:

In chemistry, **pH** ('potential of hydrogen' or 'power of hydrogen') is a scale used to specify the acidity or basicity of an aqueous solution.

- pH is calculated as the negative log of the concentration of hydrogen ion of a solution.
- $\text{pH} = -\log_{10}[\text{H}^+]$
- The range of pH scale: 0 to 14
- Anything below 7.0 is acidic
- Anything above 7.0 is alkaline, or basic.
- Anything 7.0 is neutral.

Q. Identify whether the following substances are acid or alkali or neutral.

Substance	pH	Type	Substance	pH	Type
Gastric juice	0.0		Milk	6.8	
lemon juice	1.0		Pure water	7.0	
Vinegar	1.2		Human Blood	7.4	
Apples	2.2		Tears	7.4	
Soft drinks	2.8		Egg	7.8	
Wine and Beer	3.0		Baking Soda	8.3	
Tomatoes	3.0		Milk of Magnesia	10.5	
Black coffee	4.0		Ammonia	11.0	
Human saliva	4.5		Lime	12.4	
Rain water	5.0		Sodium Hydroxide	14.0	
Table salt	6.4		Oven cleaner	13.8	

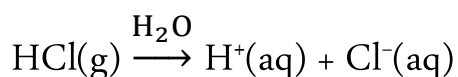
Acid:

The word acid comes from a Latin word '**acere**' which means '**sour**'.

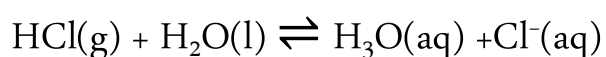
An acid is any hydrogen-containing substance that is capable of donating a proton (hydrogen ion) to another substance.

The chemical substances which have one or more Hydrogen atom may produce H^+ in water are called acids.

- Arrhenius first defined acids as compounds which ionize to produce hydrogen ions.



- According to the Bronsted-Lowry definition, an acid is a proton donor.



HCl acts as an acid and water is a base.

Why is CH_3COOH
an acid?

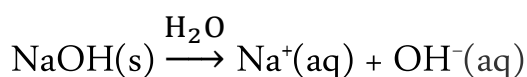
Ans:

Base:

A base is a molecule or ion able to accept a hydrogen ion from an acid.

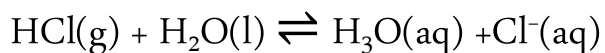
Metallic oxides or hydroxides or carbonates which produce (OH^-) hydroxyl ion in water are bases.

- Arrhenius first defined bases as compounds which ionize to produce hydroxide ions.



✓ CuO , MgO , PbO , $\text{Al}(\text{OH})_2$ etc. are not soluble in water.

- According to the Bronsted-Lowry definition, a base is a proton acceptor.



HCl acts as an acid and water is a base.

Why is $\text{Ca}(\text{OH})_2$ a base?



Ans:

Alkalis:

The soluble **bases** are called alkalis.

- Alkalis are those bases which dissolve in water.
- NaOH , KOH , $\text{Ca}(\text{OH})_2$, $\text{Mg}(\text{OH})_2$ etc. are alkalis

Q. Why is NH_3 an alkali?

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Q. Alkalis are base but all bases are not alkali.—Explain.

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Theories of Acids and Bases

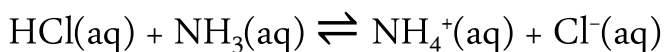
Three different theories have been put forward in order to define acids and bases.

- The **Arrhenius theory** of acids and bases states that “an acid generates H^+ ions in a solution whereas a base produces an OH^- ion in its solution”.
- The **Bronsted-Lowry theory** defines “an acid as a proton donor and a base as a proton acceptor”.
- Finally, the **Lewis definition** of acids and bases describes “acids as electron-pair acceptors and bases as electron-pair donors”.

Conjugate Acid – Base Pairs

- NH_4^+ like HCl can donate a proton and hence an acid. Since it has come from the base ammonia, it is called as a conjugate acid of base ammonia.
- Similarly, Cl^- like ammonia can accept a proton and hence a base. It is considered as the conjugate base of the acid HCl.

The Bronsted–Lowry transfer can be written as—



Acid + Base \rightarrow Conjugate acid + Conjugate base

Lewis Acid

Lewis Acids are the chemical species which have empty orbitals and are able to accept electron pairs from Lewis bases.

H⁺ ions (or protons) can be considered as Lewis acids along with hydronium ions like H₃O⁺.

Lewis Base

Atomic or molecular chemical species having a highly localized HOMO (The Highest Occupied Molecular Orbital) act as Lewis bases. These chemical species have the ability to donate an electron pair to a given Lewis acid.

- The most common Lewis base is ammonia (NH₃).

Q. Why is CH₄ not an acid? —Explain.

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