**ACIDS AND BASES**

PROPERTIES OF ACIDS:

* They are sour to taste.
* They turn blue litmus to red.
* They react with base to form salt and water.
* They are corrosive in nature.
* They are good conductors of heat and electricity

PROPERTIES OF BASES:

* They are bitter to taste.
* They turn red litmus to blue.
* They react with acid to form salt and water.
* They are soapy nature to touch.
* They are good conductors of heat and electricity.

ARRHENIUS THEORY OF ACIDS AND BASES:

It was proposed by Arrhenius in 1887.

* Acid: A substance which gives H+ ions in aqueous solution is called an acid

Ex: HCl , H2SO4 , etc..

* Base: A substance which gives OH**-** ions in aqueous solution is called a base

Ex: NaOH , KOH , etc…

* Neutralization: The process of acid reacts with base to form salt and water is called as neutralization.

Ex: HCl + NaOH 🡪 NaCl + H2O

(acid) (base) (salt) (water)

* Limitations:

1. This theory only applicable for aqueous solution.
2. It cannot explain the acidic nature of CO2 , SO2 , etc…
3. It cannot explain the basic nature of NH3 , CaO , etc….

BRONSTED LOWRY THEORY OF ACIDS AND BASES:

* It was proposed by Bronsted Lowry in 1923.
* It is also known as proton theory of acids and bases.
* Acid: A substance which can donate a proton is called acid.

Ex: HCl , H2SO4 , etc..

* Base: A substance which can accept a proton is called base

Ex: H2O , NH3 , Cl**-** , Br**-** , etc…

* Neutralization: The process of transfer of proton from acid to base to form conjugate acid and conjugate base is called neutralization.

Ex-1: HCl + H2O ⇌ H30**+** + Cl**-**

**(acid) (base) (conj. acid) (conj.base)**

Ex-2: NH3 +HCl ⇌ NH4**+** + Cl**-**

* Limitations:

1. It cannot explain the acidic nature of CO2 , SO2 , etc…
2. It can not explain the basic nature of Cao, BaO , etc…
3. It cannot explain the neutralization of CO2 and CaO.

Ex: CO2 + CaO 🡪 CaCO3.

LEWIS THEORY OF ACIDS AND BASES:

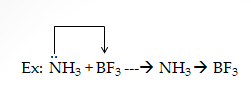
* It was proposed by lewis in 1923.
* Acid: A substance which can accept the electron pair and forms co-ordinate covalent bond is called acid.

Ex: BF3 , AlCl3 , etc…

* Base: A substance which can donate the electron pair and forms co-ordinate covalent bond is called base.

Ex: NH3 , H2O , Cl**-** , Br**-** , etc…

* Neutralization: The process of co-ordinate covalent bond formed between acid and bases is called neutralization.



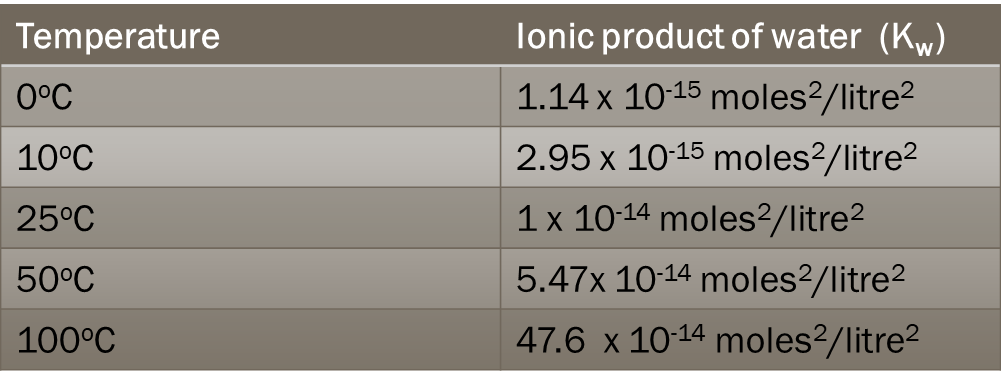
* Limitations:

1. It cannot explain the acids HCl , H2SO4 , HNO3 , etc…
2. It cannot explain the strengths of acids and bases.
3. Generally acid-base reactions are fast , but lewis acid-base reactions are slow.

* IONIC PRODUCT OF WATER: The product of molar concentration of H+ and OH- ions at any temperature of aqueous solution is called ionic product of water.
* It is denoted by “Kw”
* Kw  = [H+ ] [OH-]
* Kw  = 1 x 10-14 moles2/litre2 at 25oC
* Significance:

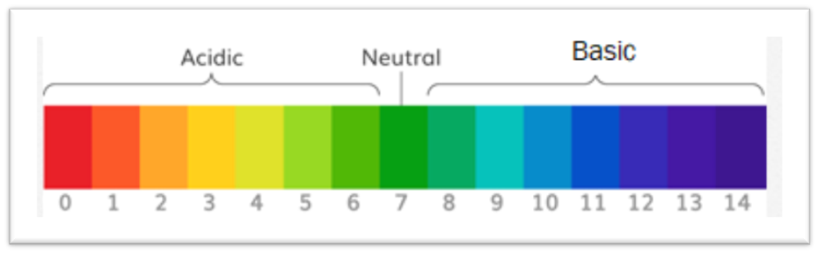
1. If [H+ ] = [OH-] then the solution is neutral.
2. If [H+ ] > [OH-] then the solution is acidic.
3. If [H+ ] < [OH-] then the solution is basic.

* Note:



* PH : The negative logarithm of concentration of H+ ion is Called PH
* PH = -log [H+ ]
* PH – scale (or) S.P.Sorenson scale:

1. It was proposed by S.P.Sorenson.
2. The range of PH is “0” to “14”.



* Significance:

1. For acidic solutions : PH<7.
2. For basic solutions : PH>7.
3. For neutral solutions : PH=7.

* Importance of PH :

1. Blood has o Specific PH  (i.e,7.35) ,and this always be maintained.
2. Crops requires soils of specific PH  (i.e,7) for good yields.
3. Many analytical procedures takes place at specific PH.
4. Biological processes and Industrial processes takes Place at specific PH.

PROBLEMS:

* Formulae:

1. PH = -log [H+ ] (For acids)
2. POH = -log [OH- ] (For bases)
3. PH  + POH  = 14.
4. [H+ ] = 10- PH

* Note:

1. log(a x b) = log a + log b.
2. log an = n x log a.
3. log1=0.
4. log10=1.

Model-1:

* Find the PH of 0.05M H2SO4 .

Ans: PH = -log [H+ ]

given that , [H+ ] = 0.05M

= 5/100 = 5/102

= 5 x 10-2.

basicity = 2

[H+ ] = 5 x 2 x 10-2

= 10 x 10-2

[H+ ] =10-1

Since , PH = -log [H+ ]

= -{log(10-1 ) }

=-{-1 x log10}

= -{ -1 x 1}

= -{-1}

= 1.

* Find the PH of 0.01N HNO3 .

Ans: PH = -log [H+ ]

given that , [H+ ] = 0.01N

= 1/100 = 1/102

= 1 x 10-2.

[H+ ] = 1 x 10-2

Since , PH = -log [H+ ]

= -{log(1 x 10-2 ) }

=-{log1 + log 10-2} (log(a x b) = log a + log b )

= -{ 0 + log 10-2 } (log an = n x log a)

= -{-2 log10} (log10=1)

= -{-2}

=2.

Model-2:

* Calculate the PH of 0.001M NaOH.

Ans: POH = -log [OH- ]

given that , [OH- ] = 0.001M

= 1/1000=1/103

[OH- ]= 1 x 10-3.

acidity =1

[OH- ]= 1 x 1 x 10-3.

[OH- ]= 1 x 10-3.

since, POH = -log [OH- ]

= -{log(1 x 10-3 ) }

=-{log1 + log 10-3} (log(a x b) = log a + log b )

= -{ 0 + log 10-3 } (log an = n x log a)

= -{-3 log10} (log10=1)

= -{-3}

POH =3.

Since, PH  + POH  = 14.

PH  = 14 - POH

= 14 – 3. = 11.

Model-4:

* PH of a solution is 6.58 . Calculate the hydrogen ion concentration in the solution.

Ans: [H+ ] = ?

given that , PH = 6.58.

since , [H+ ] = 10- PH

= 10 -6.58

[H+ ] = 2.630 x 10- 7. moles / lit.

* Buffer solution: A Solution whose pH does not changes by adding small amount of strong acid (or) strong base is called buffer solution.
* Types:- They are two types

1. Acidic buffer solution: A solution which contains weak acid and strong basic salt is called acidic buffer solution.

Ex-1:- CH3COOH +CH3COONa

Ex-2:- H2CO3+ NaHCO3

1. Basic buffer solution:-A solution which contains weak base and strong acidic salt is called basic buffer solution.

Ex-1:-NH4OH + NH4Cl

Ex-2:- Cu(OH)2 + CuSO4

APPLICATIONS (OR) USES:

1. They are used in water-softening process.
2. They are used in tonics and Syrups.
3. They are used in agriculture and dairy Products
4. They are used in Fermentation Process.
5. They are used in Bio-chemical reactions.
6. They are used in chemical and industrial purpose.
7. Conjugate acid-base pair: A pair of acid- base differ by a single proton is called conjugate acid- base pair.

Ex-1:- HCl , Cl**-**

Ex-2:- H30**+** , H2O   
Ex-3:- NH4+  , NH3

Ex-4:- HNO3 , NO3-  , etc….

* Types of lewis acids: They are 3 types.

1. Simple cations:- Ex: H+ , Na+ , Mg2+ , etc..
2. Molecules:- Ex: BF3 , BCl3 , AlCl3 , etc..
3. Molecules containing double bonds:- Ex:CO2 , SO2 , NO2 , etc…

Types of lewis bases:

* They are 3 types.

1. Simple anions:- Ex: OH- , Cl- , Br - , etc..
2. Molecules:- Ex: NH3 , H2O , etc..
3. Molecules containing multiple bonds:- Ex:C2H4 , C2H2 , etc…

INNOVATIVE PROBLEMS:

1. 4gm of NaOH are dissolved in 1lit of solution . Calculate the PH of solution .

Ans: PH = ?

POH = -log [OH- ]

Given that , Wt = 4gm

G.Eq.Wt of NaOH = G.M.Wt of NaOH / Acidity

G.M.Wt Of NaOH = Na+ O + H

=23+16+1

= 40gm

Acidity = 1.

G.Eq.Wt of NaOH = 40 / 1 = 40gm.

, Normality= Wt. x 1000

G.Eq.Wt Vml

= 4 x 1000

40 1000

= 1/10

[OH- ] = 10-1

since, POH = -log [OH- ]

= -{log(10-1 ) }

=-{ log 10-1}

= -{-1 log10} (log an = n x log a)

= -{-1 log10} (log10=1)

= -{-1}

POH =1.

Since, PH  + POH  = 14.

PH  = 14 - POH

= 14 – 1. = 13.

PRACTICE PROBLEMS:

1. Find the PH of 0.001M HCl.
2. Find the PH of 0.02N H2SO4 .
3. Calculate the PH of 0.002M Ba(OH)2 .
4. If a solution has PH of 5.81 at 25oC. calculate the H+ ion concentration

O.365gm of HCl is dissolved in 1lit of water . Calculate the PH of solution