Pakistan School
Kingdom of Bahrain

Grade :10th

Subject: Chemistry

Welcome to
E-Learning

ImaanBoosters

#seekingknowledge

CHEMISTRY
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Periodic Table of the Elements

1												13	14	15	16	17	18
1 H 1.01	2																2 He 4.00
3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.30	3	4	5	6	7	8	9	10	11	12	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 30.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (97.91)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.75	52 Te 127.60	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	57 La 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po (208.98)	85 At (209.99)	86 Rn (222.02)
87 Fr (223.02)	88 Ra (226.03)	89 Ac (227.03)	104 Rf (261.11)	105 Ha (262.11)	106 Sg (263.12)												

58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (144.91)	62 Sm 150.36	63 Eu 151.97	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97
90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np (237.05)	94 Pu (244.06)	95 Am (243.06)	96 Cm (247.07)	97 Bk (247.07)	98 Cf (251.08)	99 Es (252.08)	100 Fm (257.10)	101 Md (258.10)	102 No (259.10)	103 Lr (262.11)

Virtual Classroom Rules

Select a quiet place to study.

Be on time.

Come to class prepared in every way to learn and participate.

Virtual Classroom Rules

Be respectful.

Listen to & follow directions.

Turn off your video before joining the class.

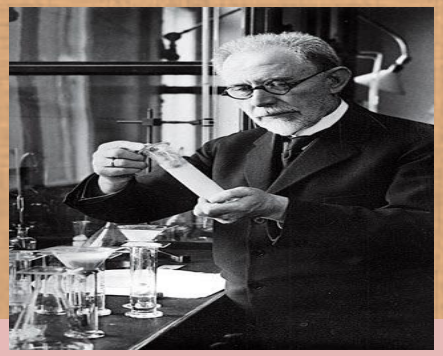
I hope you will follow all the above mentioned rules to make your dear teacher happy.

Lesson Objectives:

- By the end of this lesson, students will be able to:

- **Write the equation for self-ionization of water.**
- **Classify a solution as neutral, acidic or basic.**
- **Complete and balance a neutralization reaction.**

P^H and p^{OH}



- **Introduction:**

  In 1909, the Danish biochemist Soren Sorenson proposed a convenient method to express such small concentration of H^+ ions and OH^- ions by p^H and p^{OH}

P(is a German word= potex) potex means power or concentration.

- **p^H**

" p^H is defined as the negative logarithm of the molar concentration of H^+ ions in aqueous solutions".

$$P^H = -\log [H^+]$$

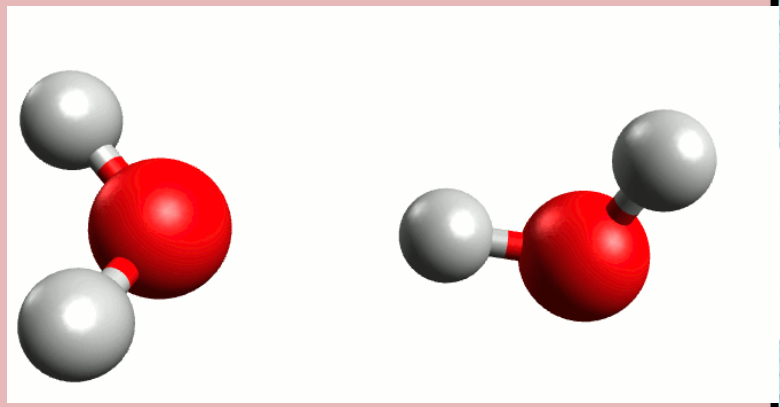
- **p^{OH}**

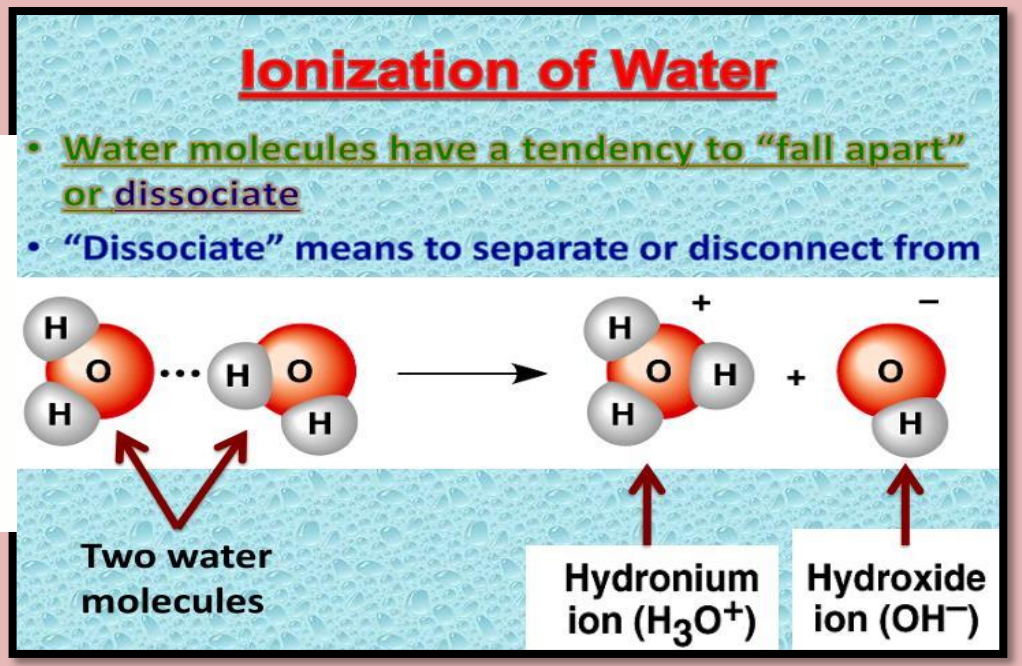
"P^{OH} is defined as the negative logarithm of the molar Concentration of OH^- ions in aqueous solution"

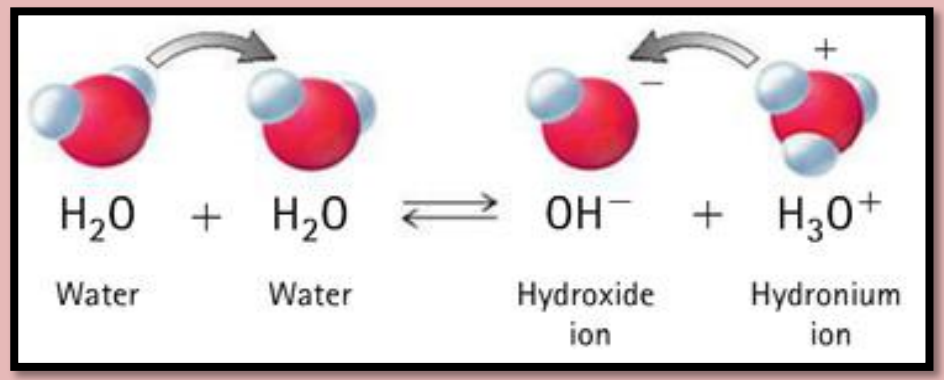
$$P^{OH} = -\log [OH^-]$$

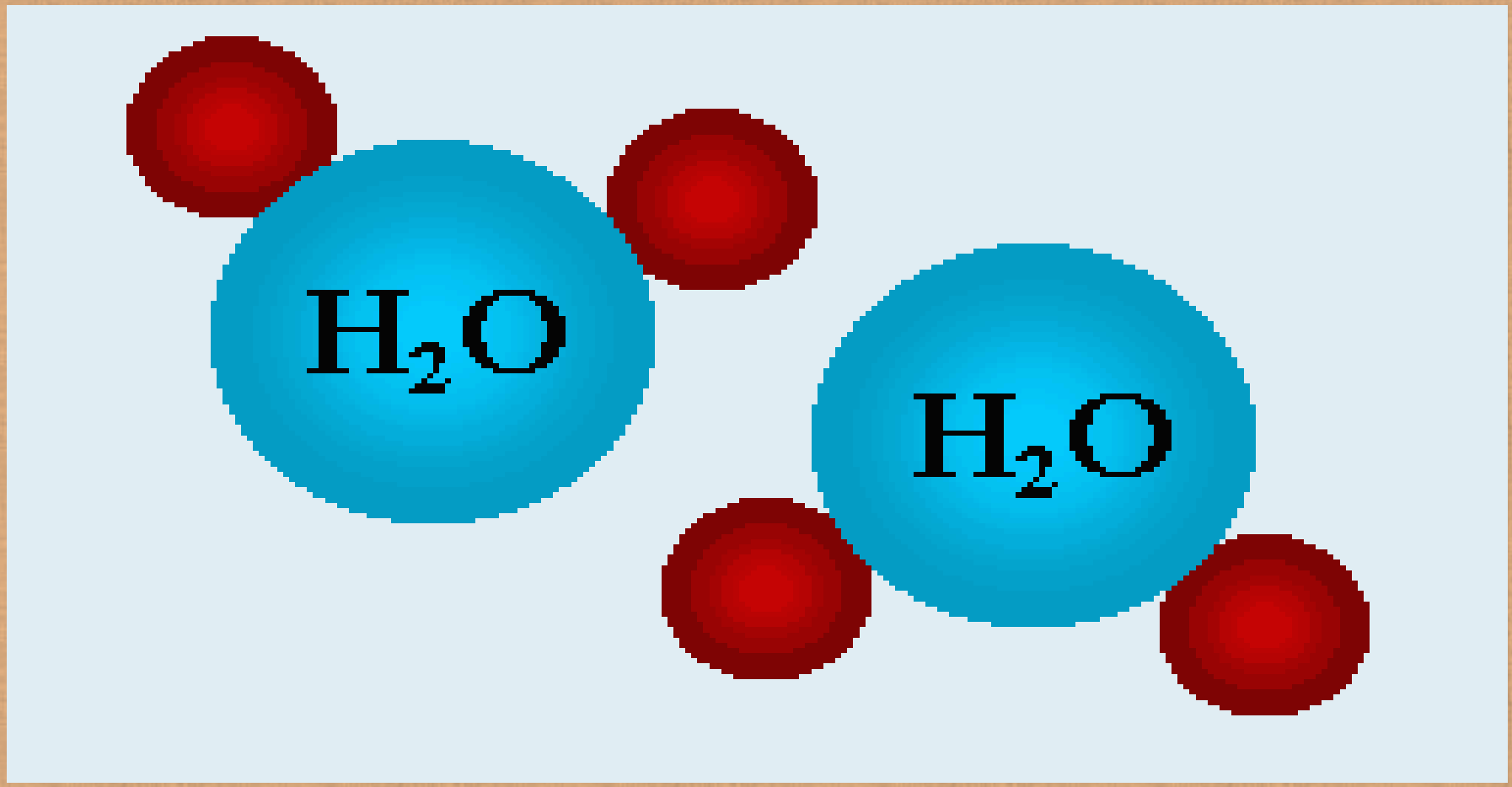
Self –ionization of water:

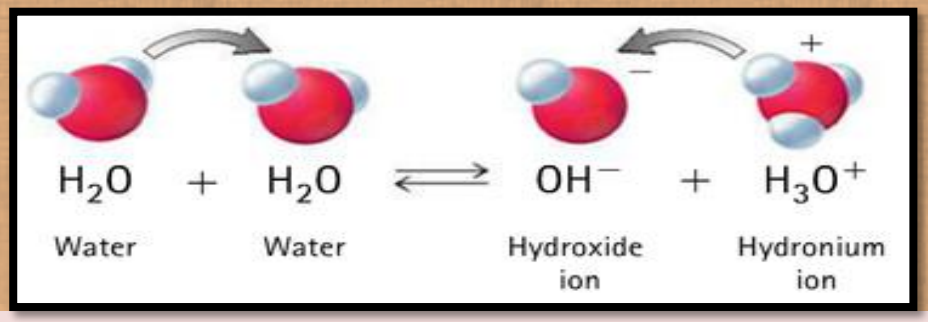
- Water molecules are highly polar. Occasionally, the collisions between water molecules are energetic enough to transfer a proton from one water molecule to another.





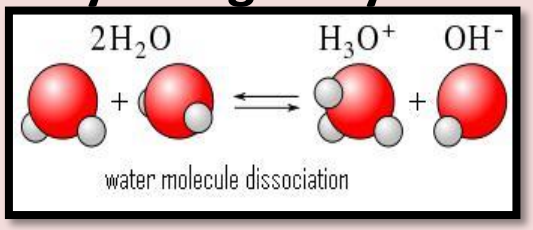



H_2O
H_2O



- **A water molecule that donates or loses a proton becomes a negatively charged hydroxide ion OH^- .The other water molecule which gains or accepts the proton becomes positively charged hydronium ion, H_3O^+**
- **This reaction can be written as,**

$2H_2O \longrightarrow H_3O^+ + OH^-$



- **The reaction in which two water molecules produce ions is called as the Self ionization or auto-ionization of water .This reaction can also be written as a simple ionization of water**
- **$H_2O \longrightarrow H^+ + OH^-$**

- **Water is a weak electrolyte. The self –ionization of water occurs to a very small extent. At 25 ^0C the experimentally determined concentrations of H^+ ions and OH^- ions are as follows.**
- **$[H^+] = [OH^-] = 1x10^{-7}$ M**

Equilibrium Constant

$$K_c = \frac{[H^+][OH^-]}{[H_2O]}$$

- Since, H_2O is a weak electrolyte, so the concentration of $[H_2O]$ will remain constant.
- $K_c [H_2O] = [H^+] [OH^-]$
- $K_w = [H^+] [OH^-]$
- Where $K_w = Kc [H_2O]$ is called **Ionization Constant for water**. It is also called **the ion – product for water.**

$\frac{1}{10^{14}}$ (very low value)

Then: $H^+ = OH^-$

$K_w = [H^+] [H^+] = 10^{-14}$

$[H^+]^2 = 10^{-14}$

Taking root on both sides; we get

$[H^+] = 10^{-7}$ (at 25 ^{0}C)

K_w – Ionization Constant for Water

In pure water at 25 °C:

$[H_3O^+] = 1 \times 10^{-7}$ mol/L

$[OH^-] = 1 \times 10^{-7}$ mol/L

K_w is a constant at 25 °C:

$Kw = [H_3O^+][OH^-]$

$Kw = (1 \times 10^{-7})(1 \times 10^{-7}) = 1 \times 10^{-14}$

$[H^+] = 10^{-7}$ (at 25 ^{0}C):

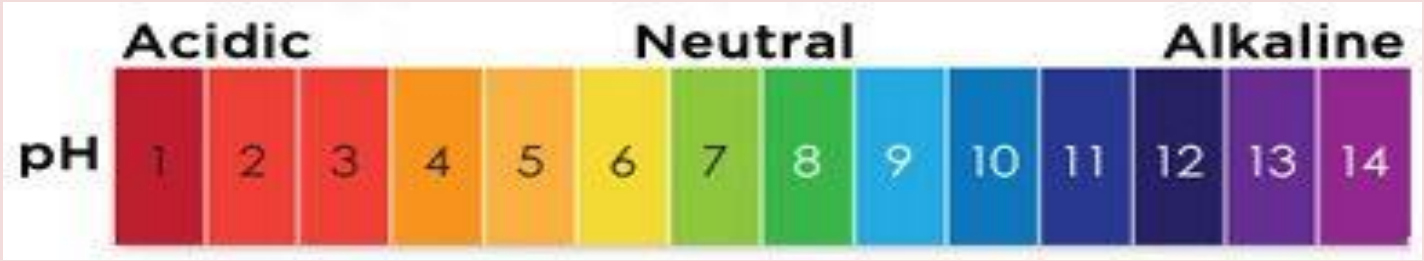
Here -7 =low value, to deal with this –ve value we will use numeric system to convert –ve value into +ve value.

To take –log

So, $P^H = -\log [H^+]$ $P^{OH} = -\log [OH^-]$

THE P^H SCALE:

Chemists use a number scale from 0 to 14 to describe the concentration of H^+ ions in a solution is known as P^H Scale.



$P^H = -\log [H^+] = -\log[1x10^{-14}] = 7$

$P^{OH} = -\log [OH^-] = -\log[1x10^{-14}] = 7$

So, its mean at 25 ^{0}C pure water is a weak acid. Because out of 10^{14} water molecule 1 will be ionized.

- $P^H + P^{OH} = 7+7=14$
- **Remember that:**
- If $[H^+] = [OH^-] = 1x10^{-7}$ Solution is neutral
- If $[H^+] > 1x10^{-7}$, Solution is acidic
- If $[H^+] < 1x10^{-7}$ Solution is basic

We now have the familiar pH scale (0-14):

If pH = 7, the solution is neutral

pH > 7, the solution is basic

pH < 7, the solution is acidic

Self Assessment Exercise 10.3: Classify a solution as neutral, acidic or basic.

1) A soft drink has $[H^+] = 3x10^{-3}$ M.Is drink acidic, neutral or basic?

Data:

Concentration of $[H^+] = 3x10^{-3}$

Remember that:

If $[H^+] = [OH^-] = 1x10^{-7}$
Solution is neutral

If $[H^+] > 1x10^{-7}$
Solution is acidic

If $[H^+] < 1x10^{-7}$
Solution is basic

- **Solution:**

$[H^+] = 3x10^{-3} > 1x10^{-7}$ M, The solution is acidic

RESULT:

Because, $3x10^{-3}$ M > $1x10^{-7}$ M ,The solution is acidic.

2) Ordinary vinegar is approximately 1M CH_3COOH.Concentration of H^+ in it is $4.2x10^{-3}$ M.Is vinegar acidic ,basic or neutral?

Remember that:

If $[H^+] = [OH^-] = 1x10^{-7}$
Solution is neutral

If $[H^+] > 1x10^{-7}$
Solution is acidic

If $[H^+] < 1x10^{-7}$
Solution is basic

Data:

Concentration of $[H^+] = 4.2x10^{-3}$ M.

Solution:

$[H^+] = 4.2x10^{-3} > 1x10^{-7}$ M, The solution is acidic

RESULT:

Because , $4.2x10^{-3}$ M > $1x10^{-7}$ M ,The solution is acidic

3) A student determines the $[OH^-]$ of milk of magnesia, a suspension of solid magnesium hydroxide in its saturated solution & obtains a value of $4.2x10^{-3}$ M.Is the solution acidic, neutral or basic?

Remember that:

If $[H^+] = [OH^-] = 1x10^{-7}$
Solution is neutral

If $[H^+] > 1x10^{-7}$
Solution is acidic

If $[H^+] < 1x10^{-7}$
Solution is basic

Data:

Concentration of $[OH^-] = 4.2x10^{-3}$

$[H^+]$ = ?

If $[OH^-]$ is given,calculate $[H^+]$ from $K_w = [H^+]\,[OH^-]$

$K_w = [1.0x10^{-14}]$

Solution:

$$K_w = [H^+]\,[OH^-]$$

By putting values:

$$[1.0x10^{-14}] = [H^+]\,[4.2x10^{-3}]$$

$$[H^+] = \frac{[1.0x10^{-14}]}{[4.2x10^{-3}]} = 0.2x10^{-11}\ M$$

$[H^+] = 0.2x10^{-11} < 1x10^{-7}$ M, The solution is Basic.

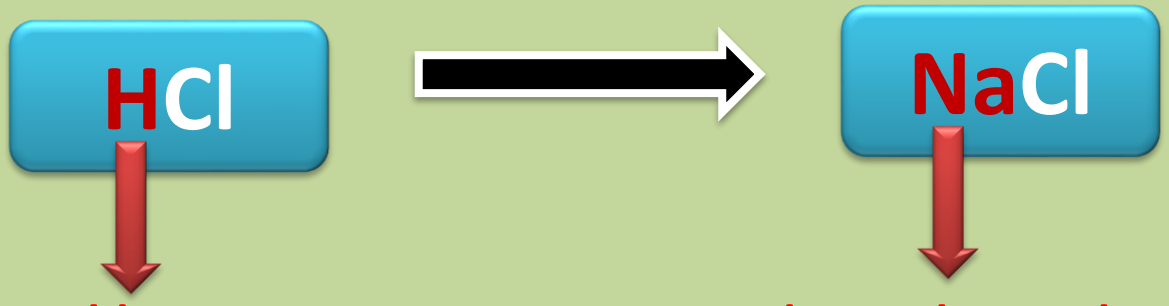
RESULT:

Because , $0.2x10^{-11}$ M < $1x10^{-7}$ M ,The solution is Basic

Salts

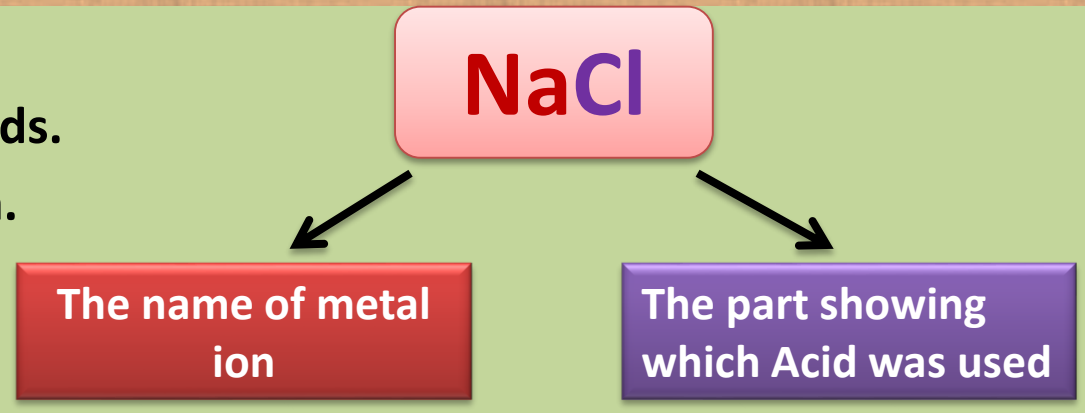
Definition:

An acid contains replaceable hydrogen atoms. When these are completely or partially replaced by metal atoms, a compound called salt is formed.



Properties of salts:

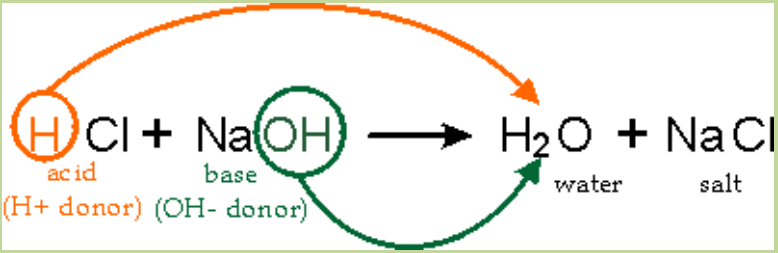
- Salts are ionic compounds.
- Neutralization Reaction.
- Cation & Anion.



- Identify salt

Acid	Salt name	Example
Hydrochloric HCl	Chloride Cl^{-}	NaCl , KCl , $CaCl_2$
Nitric HNO_3	Nitrate NO_3^{-1}	$NaNO_3$, KNO_3 , $Ca(NO_3)_2$
Sulphuric H_2SO_4	Sulphate SO_4^{-2}	Na_2SO_4 , K_2SO_4 , $CaSO_4$
Phosphoric H_3PO_4	Phosphate PO_4^{-3}	Na_3PO_4 , K_3PO_4 , $Ca_3(PO_4)_2$

Neutralization



Reaction between an acid and a base is called neutralization reaction.

Acid + Base → Salt + water

HCl + NaOH → NaCl + H_2O

Neutralization is the reaction between H^+ ions of an acid and OH^- ions of a base.

H^+ + $0H^-$ → H_2O

Types of Salts:

Normal salt

"A Salt which is formed by the complete neutralization of an acid is called Normal salt"

Example: Na_2SO_4 , K_2CO_3 , Na_3PO_4

Acidic salt

"A Salt which containing a replaceable H-atom or formed by partial neutralization of an acid is called Acidic Salt".

Example: $NaHCO_3$, $KHCO_3$, Na_2HPO_4

Basic salt

"A Salt containing replaceable OH group or formed by the partial neutralization of a polyhydroxy base is called as Basic Salt".

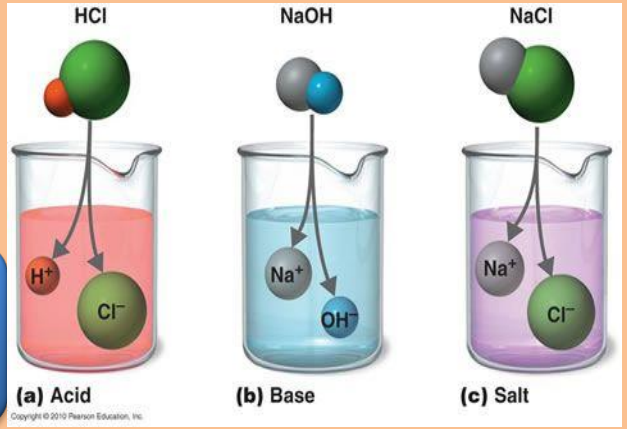
Example: Zn (OH) Cl , Pb (OH) CH3COO

Methods for making Salts:

There are five methods for making Salts.

Acid + Base → Salt + Water

$HCl + NaOH \rightarrow NaCl + H_2O$



Acid + Metal oxide → Salt + Water

$H_2SO_4 + CuO \rightarrow CuSO_4 + H_2O$

Acid + Metal → Salt + Hydrogen gas

$2HCl + Mg \rightarrow MgCl_2 + H_2$

Acid + Metal carbonate → Salt + Carbon dioxide + Water

$2HCl + CaCO_3 \rightarrow CaCl_2 + CO_2 + H_2O$

Salt + Salt → Salt + Salt

$AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$

Salt Formulas

cation	anion	compound
Ca^{+2}	Cl^{-1}	$CaCl_2$
Ba^{+2}	O^{-2}	BaO
K^{+1}	S^{-2}	K_2S
Fe^{+3}	Br^{-1}	$FeBr_3$
Cr^{+3}	O^{-2}	Formula ?

Salt formation

Examples of salts

Salt	Formula	Metal ion	Non-metal ion
Copper sulphate	$CuSO_4$	Cu^{2+}	SO_4^{2-}
Sodium chloride	$NaCl$	Na^+	Cl^-
Potassium nitrate	KNO_3	K^+	NO_3^-
Calcium sulphate	$CaSO_4$	Ca^{2+}	SO_4^{2-}

Q: Write balance chemical equations for the following:

(i) Sulphuric acid + Magnesium hydroxide ⟶ Magnesium sulphate + Water

(ii) Sulphuric acid + Sodium hydroxide ⟶ Sodium sulphate + Water

(iii) Hydrochloric acid + Calcium hydroxide ⟶ Calcium chloride + Water

i. $H_2SO_4 + Mg(OH)_2 \longrightarrow MgSO_4 + H_2O$

ii. $H_2SO_4 + 2NaOH \longrightarrow Na_2SO_4 + 2H_2O$

iii. $2HCl + Ca(OH)_2 \longrightarrow CaCl_2 + 2H_2O$

Q: Complete and balance the following chemical reactions:

(i) H_2SO_4 + CuO ⟶

(ii) HCl + $CaCO_3$ ⟶

(iii) $AgNO_3$ + NaCl ⟶

Ans:

i. H_2SO_4 + CuO ⟶ $CuSO_4$ + H_2O

ii. 2HCl + $CaCO_3$ ⟶ $CaCl_2$ + H_2O + CO_2

iii. $AgNO_3$ + NaCl ⟶ AgCl + $NaNO_3$

Q: Balance the following chemical reactions:

(i) $H_2CO_3 + NaOH \longrightarrow Na_2CO_3 + H_2O$

(ii) $HNO_3 + Ba(OH)_2 \longrightarrow Ba(NO_3)_2 + H_2O$

(iii) $H_3PO_4 + NaOH \longrightarrow Na_3PO_4 + H_2O$

Ans:

(i) $H_2CO_3 + 2\,NaOH \longrightarrow Na_2CO_3 + 2\,H_2O$

(ii) $2\,HNO_3 + Ba(OH)_2 \longrightarrow Ba(NO_3)_2 + 2\,H_2O$

(iii) $H_3PO_4 + 3\,NaOH \longrightarrow Na_3PO_4 + 3H_2O$

Plenary

(i) A solution that has hydrogen ion concentration 1.0×10^{-3} M.
(ii) A solution that has hydrogen ion concentration 1.0×10^{-10} M.
(iii) A solution that has hydroxyl ion concentration 1.0×10^{-3} M.
(iv) A solution that has hydroxyl ion concentration 1.0×10^{-3} M.

- An aqueous solution of NaOH is used as a drain cleaner .If the concentration of OH^- ions in the solution is 1.0×10^{-5} M, the concentration of H^+ ions in it would be?
- A) 1.0×10^{-5}M B) 1.0×10^{-7}M C) 1.0×10^{-9}M D) 1.0×10^{-14}M

- Define P^H and p^{OH}

Home Work

SOLVE:

- **Self Assessment Exercise.10.4**
- **Self Assessment Exercise.10.7**
- **Review Questions:16,17,18,19**


Let's Stop COVID-19
Stay
Home
Stay Safe
WORK
FROM HOME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خدا حافظ
في أمان الله
May Allah protect you
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WAY OF SAYING GOODBYE]
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