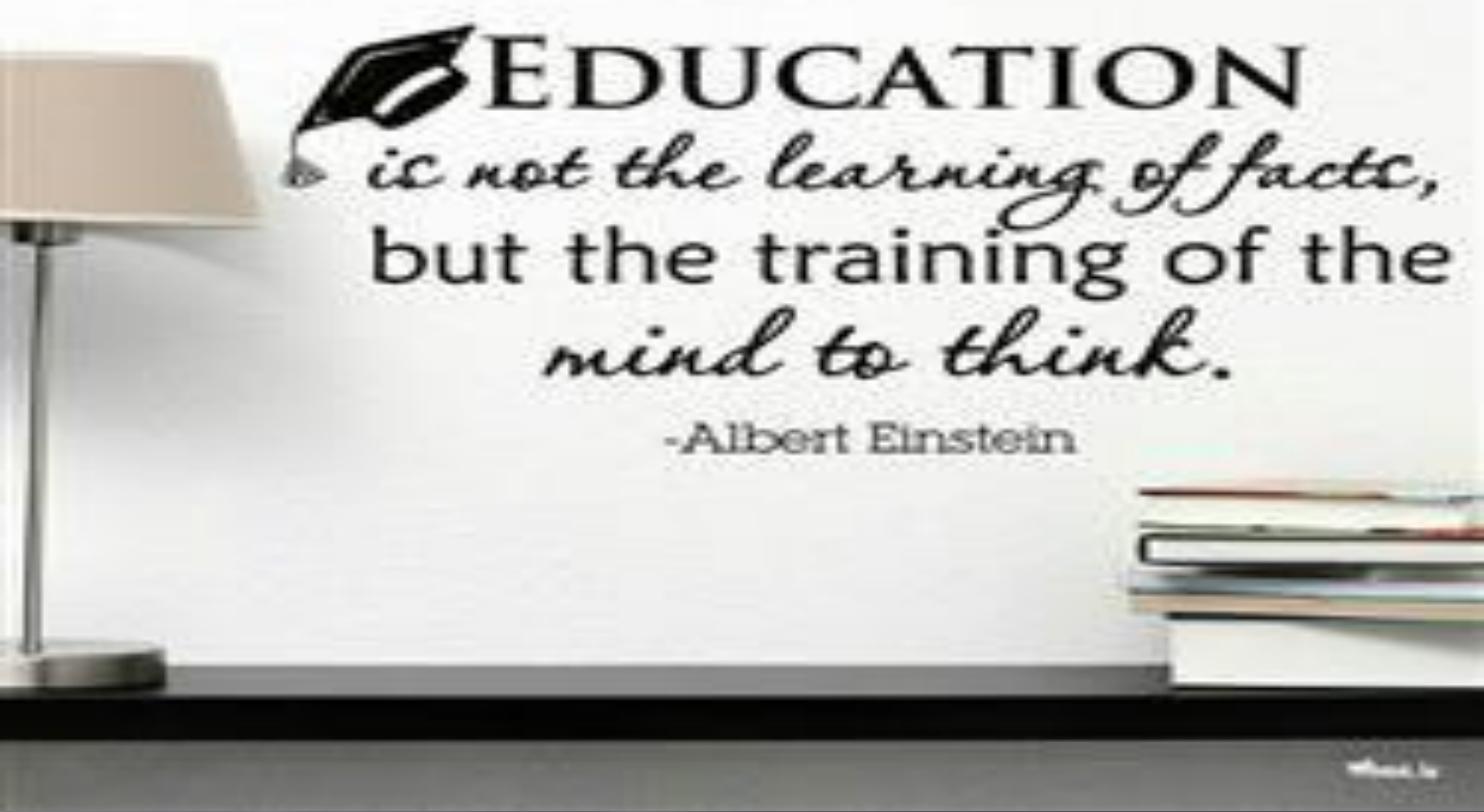
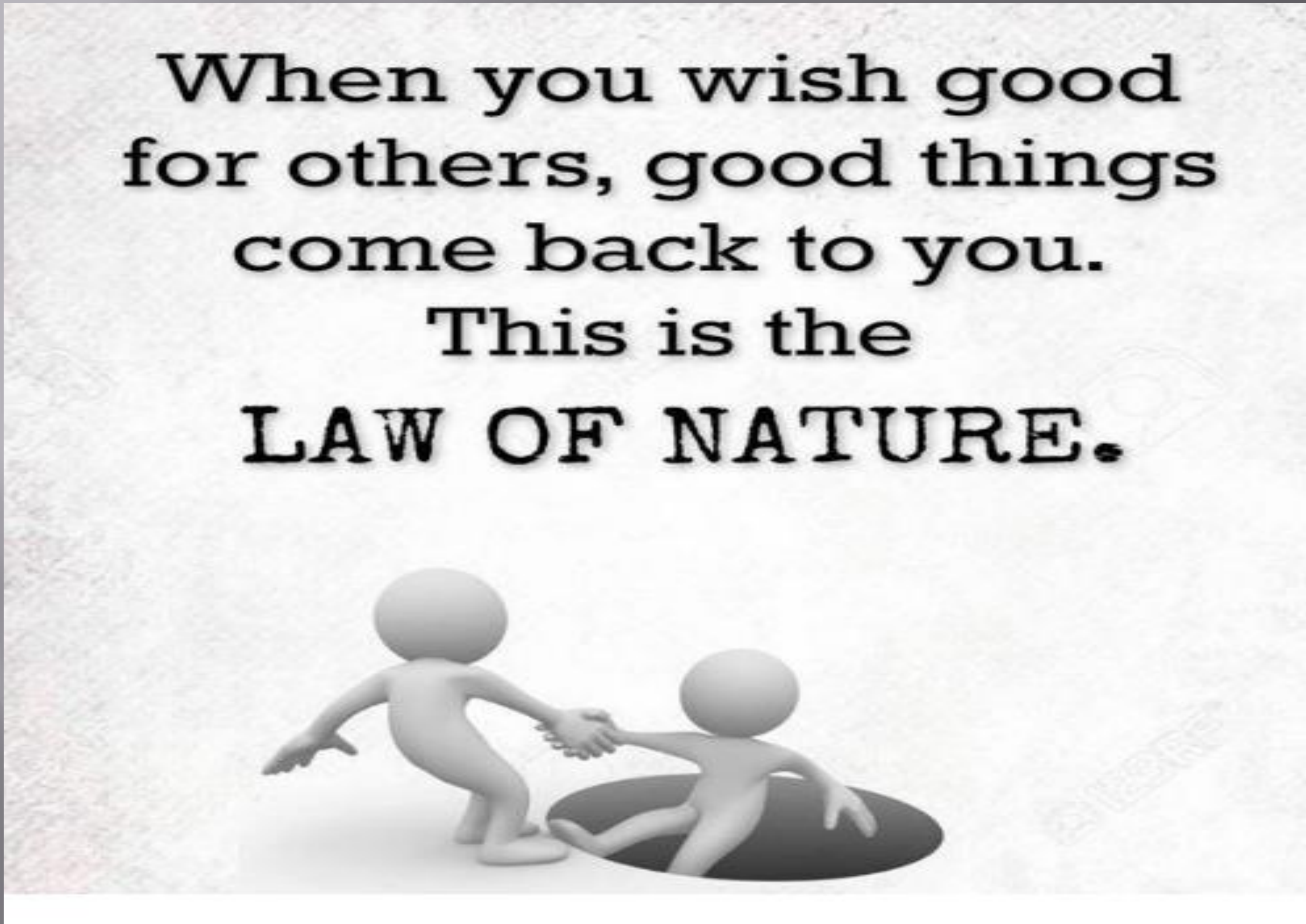
Pakistan School
Kingdom of Bahrain




2+2
WELCOME
BACK


>> Ready for Anything
WELCOME BACK TO
VIRTUAL CLASSES!
#WEAREALWAYSTOGETHER
AMERICAN


When you wish good
for others, good things
come back to you.
This is the
LAW OF NATURE.

WARM WELCOME

- A WARM WELCOME TO ALL THE STUDENTS IN ONLINE CLASSES. THIS IS D.CHARLES TEACHER SENIOR SECTION (BOYS).WE ARE GOING TO START OUR ONLINE GENERAL CLASS TODAY.
- I HOPE YOU WILL LEARN AND ENJOY.
- RULES OF THE CLASS ROOM:1)BE ON TIME FOR ALL YOUR CLASSES.2)RESPECT ALL PARTICIPANTS OF THE CLASS.3)DO NOT CREATE ANY DISTURBANCES .4) RAISE YOUR HAND IF YOU HAVE ANY QUESTION.5)GIVE RESPECT TO YOUR TEACHER.


wiseGEEK


Acid Rain

POINTS TO PONDER:

LESSON OBJECTIVE:

- BY THE END OF THIS PART OF LESSON,STUDENTS BE ABLE TO:
- DERIVE SELF-IONIZATION OF WATER.
- DEFINE pH ?WHAT IS THE IMPORTANCE OF Kw?
- WHAT IS pHscale? Write its importance ?
- Define indicators? why they are used?
- Define salts? How they formed?
- What is meant by neutralization?

CHARACTERISTICS:

Characteristics of Acids & Bases

Acids	Bases
•Produce H_3O^{+1} (hydronium ion) in water	•Produce OH^{-1} (hydroxide ion) in water
•Tastes sour •May sting or burn on contact	•Tastes Bitter
•React with active metals to form hydrogen gas	•Feels slippery
•Turn blue litmus paper pink	•Turns pink litmus paper blue

Properties of Acids and Bases

ACIDS	BASES
taste **sour**	taste **bitter**
do not feel slippery	feel **slippery**
pH < 7	**pH > 7**
release hydrogen (**H^+**) ions in aqueous solution	release hydroxide (**OH^-**) ions in aqueous solution
corrode metals	do not corrode metals
react with metals to produce a compound and **hydrogen gas**	do not react with metals to produce a compound and hydrogen gas
turn litmus **red/pink**	turn litmus **blue**

Acidic/Basic Characteristics

Acids

- Tend to have a tangy or sour taste
- A substance that produces hydrogen ions in solution, H^+ (aq)
- Actually produces a hydronium ion , H_3O^+ but the H^+ is used to simply the reaction equation.

Bases

- Tend to have a bitter taste and a slippery feel
- Term alkali used for base that is soluble in water with the solution said to be alkaline.
- A substance that produces hydroxide ions in solution, OH^- (aq)

Arrhenius Definition of

- Acids - Substances that produce hydrogen ions, H^+ when dissolved in water

$$HCl \rightarrow H^+ + Cl^-$$

- Bases - Substances that produce hydroxide ions, OH^- when dissolved in water

$$NaOH \rightarrow Na^+ + OH^-$$

Arrhenius theory of bases

- Arrhenius defined a base as:
  A substance that dissociates in water to produce OH^- ions.

- For example: when NaOH is added to water:

$$NaOH \longrightarrow Na^+ + OH^-$$

- In general:

$$XOH \longrightarrow X^+ + OH^-$$

The Arrhenius Theory of Acids and Bases

- Acids are substances which produce hydrogen ions H^+, in solution.

- Bases are substances which produce hydroxide ions OH^- in solution.

- Neutralization happens because hydrogen ions and hydroxide ions react to produce water.

Arrhenius Acids & Bases

- Arrhenius Acids
  - Donate H^+ to the solution
- $HNO_3 \xrightarrow{H_2O} H^+ + NO_3^-$

- Arrhenius Bases
  - Donate OH^- to the solution
- $NaOH \xrightarrow{H_2O} Na^+ + OH^-$

Common Acids

Chemical Name	Formula	Uses	Strength
Nitric Acid	HNO_3	explosive, fertilizer, dye, glue	Strong
Sulfuric Acid	H_2SO_4	explosive, fertilizer, dye, glue, batteries	Strong
Hydrochloric Acid	HCl	metal cleaning, food prep, ore refining, stomach acid	Strong
Phosphoric Acid	H_3PO_4	fertilizer, plastics & rubber, food preservation	Moderate
Acetic Acid	$HC_2H_3O_2$	plastics & rubber, food preservation, Vinegar	Weak
Hydrofluoric Acid	HF	metal cleaning, glass etching	Weak
Carbonic Acid	H_2CO_3	soda water	Weak
Boric Acid	H_3BO_3	eye wash	Weak

Name, Formula	Use	Other Information
Acetic Acid	Food Prep and Preservation	When in solution with water it is known as vinegar
Acetylsalicyclic Acid	Pain Reliever, Fever reducer	Known as aspirin
Ascorbic Acid	Antioxidant, Vitamin	Called Vitamin C
Carbonic Acid	Carbonated Drinks	Involved in cave, stalactite, and stalagmite formation and acid rain
Hydrochloric Acid	Digestion as gastric juice	Commonly called Mariatic Acid
Phosphoric Acid	Makes detergents, fertilizers, and soft drinks	Sour but pleasant taste, detergents containing phosphates polute water
Sulfuric Acid	Car batteries, fertilizers	Dehydrating agent, causes burns by removing water from cells
Nitric Acid	Makes fertilizers	Colorless, but yellow when exposed to light

Common Acids

Common Bases and Some Everyday Uses

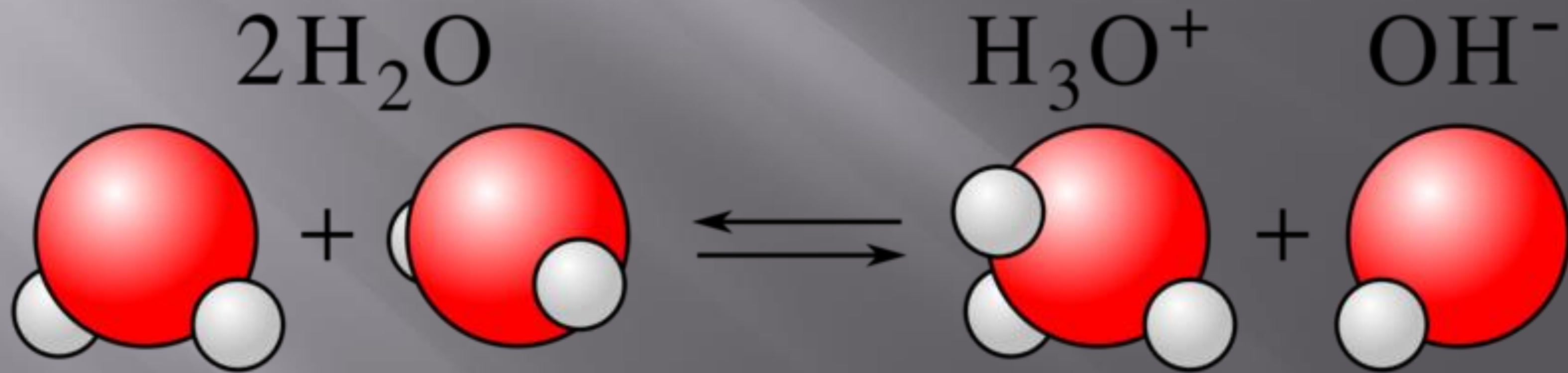
Table 13.2

Name	Formula	Uses
Sodium Hydroxide (Caustic Soda)	$NaOH$	Used in drain and oven cleaners and soap making.
Ammonia	NH_3	Household cleaners, fertilizers and explosives.
Calcium Hydroxide	$Ca(OH)_2$	Found in cement and mortar and in garden lime to adjust soil pH.
Magnesium Hydroxide	$Mg(OH)_2$	Key ingredient in some antacids.
Sodium Carbonate	Na_2CO_3	Used in manufacture of washing powder and glass.

Table 2 Examples of some common bases

Common Name	Formula	Source or use
Sodium hydroxide	$NaOH$	Drain cleaner
Potassium hydroxide	KOH	Soap, cosmetics
Aluminum hydroxide	$Al(OH)_3$	Antacids
Ammonium hydroxide	NH_4OH	Window cleaner.

POINTS TO PONDER:

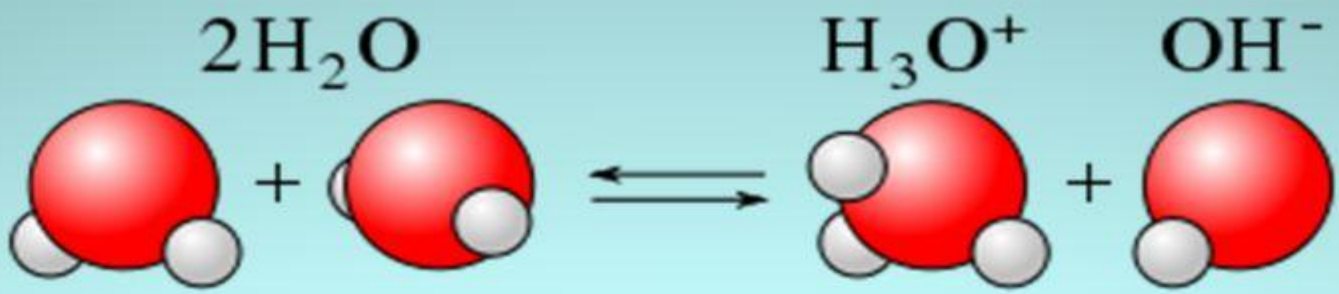


A water molecule that loses a hydrogen ion becomes a negatively charged **hydroxide ion** OH^-
A water molecule that gains a hydrogen ion becomes a positively charged **hydronium ion** H_3O^+

Self ionization of water – the reaction in which water molecules produce ions.

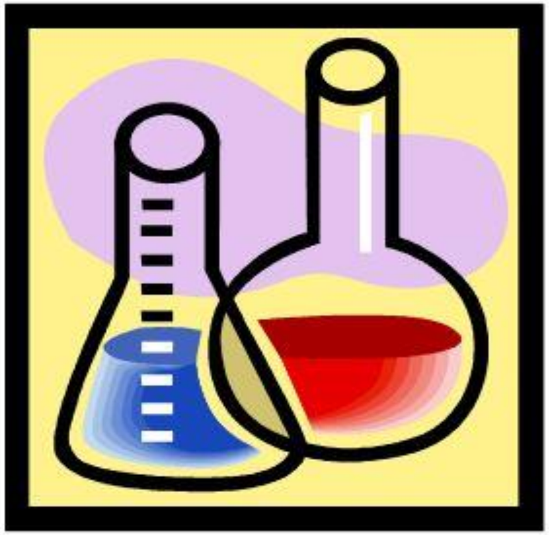
Self-ionization of water

The **self-ionization of water** (also **autoionization of water**, and **autodissociation of water**) is an ionization reaction in pure water or an aqueous solution.



Self-Ionization of Water

- Two water molecules produce a hydronium ion & a hydroxide ion by the transfer of a proton.
- $H_2O\ (l) + H_2O\ (l) \rightarrow H_3O^+(aq) + OH^-\ (aq)$
- In pure water, every time you make one H_3O^+ you get one OH^-
- That is, $[H_3O^+] = [OH^-]$



SELF-IONIZATION/Kw:

Self-Ionization Of Water

- Even the purest of water conducts electricity. This is due to the fact that water self-ionizes, that is, it creates a small amount of H_3O^+ and OH^-.

  $$H_2O + H_2O \rightleftharpoons H_3O^+ + OH^-$$

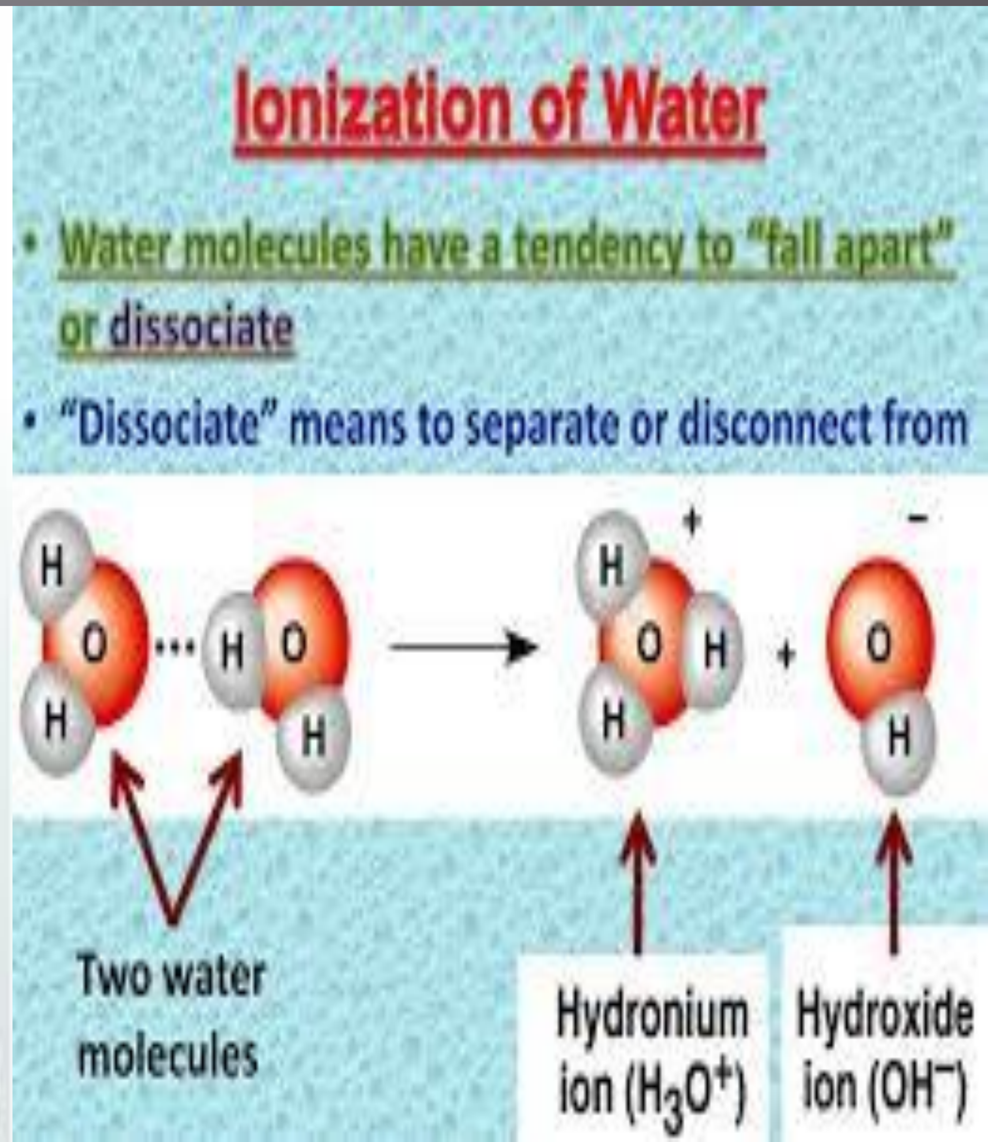
  $$K_w = [H_3O^+][OH^-]$$

- **K_w - ion product of water**

  $K_w = 1.0 \times 10^{-14}$ at 25 °C

- This equilibrium constant is very important because it applies to *all aqueous solutions* - acids, bases, salts, and non-electrolytes - not just to pure water.

POINTS TO PONDER:



Autoionization of Water

The **auto-ionization** of water is described by the equation:

$$H_2O\ (l)\ +\ H_2O\ (l) \rightleftarrows H_3O^+\ (aq)\ +\ OH^-\ (aq)$$

The **equilibrium constant** for this reaction is given by:

$$K = \frac{[H_3O^+][OH^-]}{[H_2O][H_2O]} = \frac{[H_3O^+][OH^-]}{[H_2O]^2}$$

$$K[H_2O]^2 = [H_3O^+][OH^-]$$

$K_w = K[H_2O]^2 = 10^{-14}$ This **equilibrium** lies very much to the **left** i.e. mostly water. For **pure water** $[OH^-] = [H^+] = 1 \times 10^{-7}$ M

Ionic Product of water, K_w

$$H_2O_{(l)} \rightleftharpoons H^+_{(aq)} + OH^-_{(aq)}$$

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

Since $[H_2O]$ is effectively constant and in large excess

$$K_w = [H^+][OH^-] \text{ mol}^2\text{dm}^{-6}$$

Ionic Product of water, K_w

At 298K the value of K_w is 1×10^{-14} mol^2dm^{-6}

$$K_w = [H^+][OH^-]\ mol^2dm^{-6}$$

In pure water $[H^+] = [OH^-]$

So $K_w = [H^+]^2$ Hence $[H^+] = \sqrt{K_w}$

At 298K $[H^+] = \sqrt{(1 \times 10^{-14})} = 1 \times 10^{-7}$

So at 289K the pH of pure water is 7

How is pH defined?

- The **pH of a solution is the negative logarithm of the hydrogen-ion concentration**. The pH may be represented mathematically, using the following equation:

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

  In pure water or a neutral solution, $[H^+] = 1 \times 10^{-7}M$, and the pH is 7.

  $$pH = -\log(1 \times 10^{-7})$$
  $$= -(\log 1 \times \log 10^{-7})$$
  $$= -(0.0 + (-7.0))$$
  $$= 7.0$$

- If the $[H^+]$ of a solution is greater than $1 \times 10^{-7}M$, the pH is less than 7.0. If the $[H^+]$ of the solution is less than $1 \times 10^{-7}M$, the pH is greater than 7.0.

Ph definition:

The definition of pH is the negative logarithm of the **hydrogen ion (H+) activity** in a given solution.

- The range of the ph scale is from 0 to 14.

$$pH = -\log aH^+$$

pH

For $\mathbf{H_2O_{(l)} \rightleftarrows H^+_{(aq)} + OH^-_{(aq)}}$

$$\rightarrow [H^+] = [OH^-]$$

$$[H^+] \times [OH^-] = 1 \times 10^{-14} = [1 \times 10^{-7}] \times [1 \times 10^{-7}]$$

$[H^+]$ of water is at 25^0C is 1×10^{-7} mol/litre

Replacing $[H^+]$ with pH to indicate acidity of solutions

pH 7 replaces $[H^+]$ of 1×10^{-7} mol/litre

where $\mathbf{pH = -Log_{10} [H^+]}$

IMPORTANCE OF Kw:

The Importance of K_w

- It is important to recognize the meaning of Kw. In any aqueous solution at 25˚C, no matter what the solution contains…

the product of $[H^+(aq)]$ and $[OH^-(aq)]$

must always equal 1.0×10^{-14}

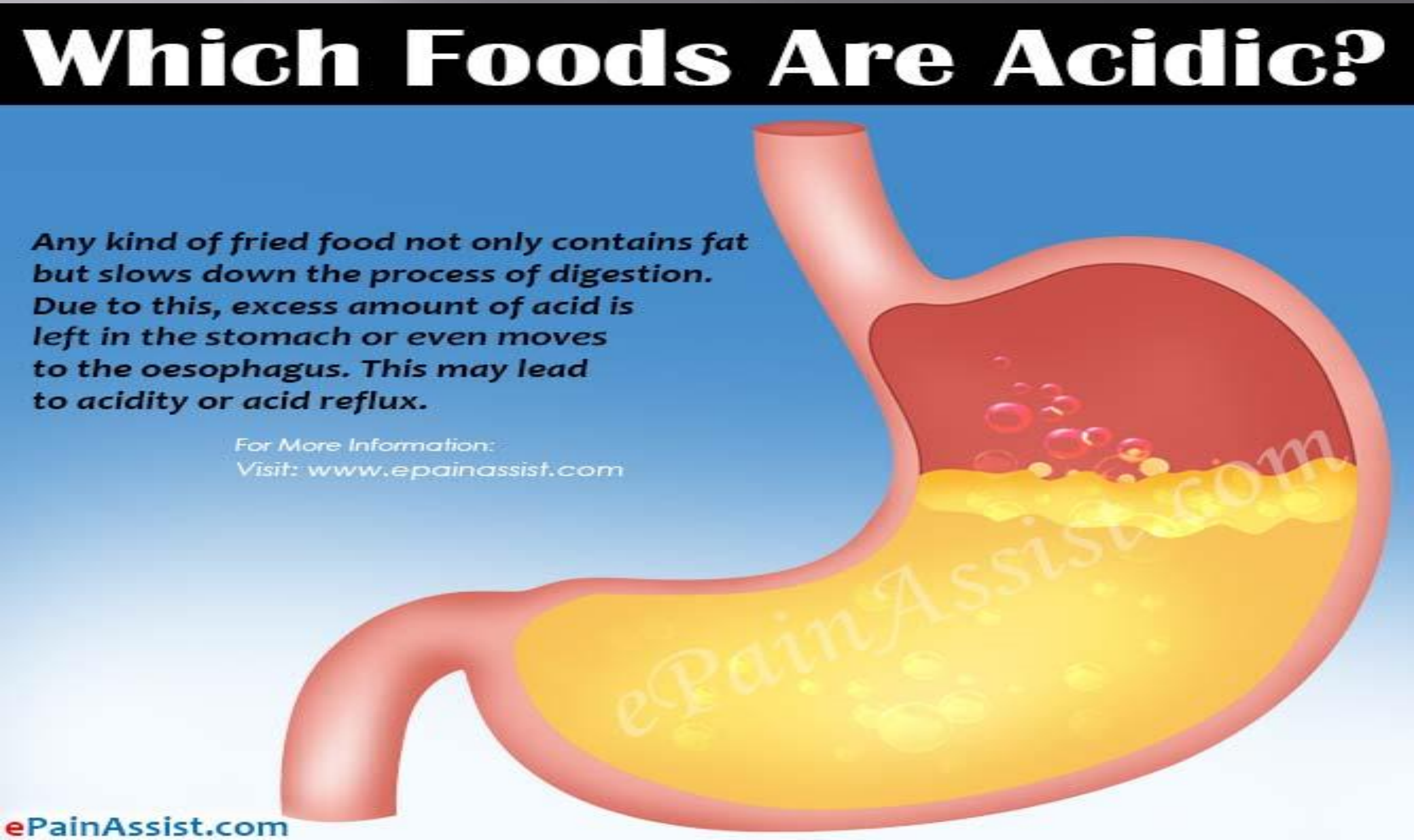
- There are three possible situations:
  1. In a NEUTRAL solution $[H_+] = [OH_-]$
  2. In an ACIDIC solution $[H_+] > [OH_-]$
  3. In a BASIC solution $[H_+] < [OH_-]$

In each case at 25˚C, $[H+(aq)]\ [OH-(aq)] = 1.0 \times 10^{-14}$

POINT TO PONDER:

POINTS TO PONDER:

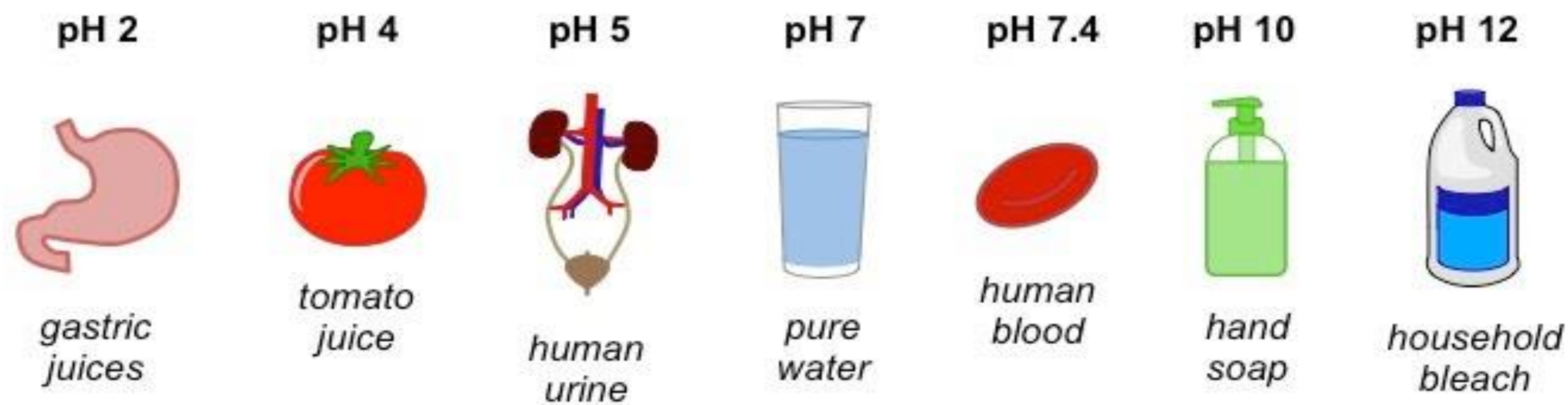
POINTS TO PONDER:



POINTS TO PONDER:

POINTS TO PONDER:

Examples of pH Conditions:



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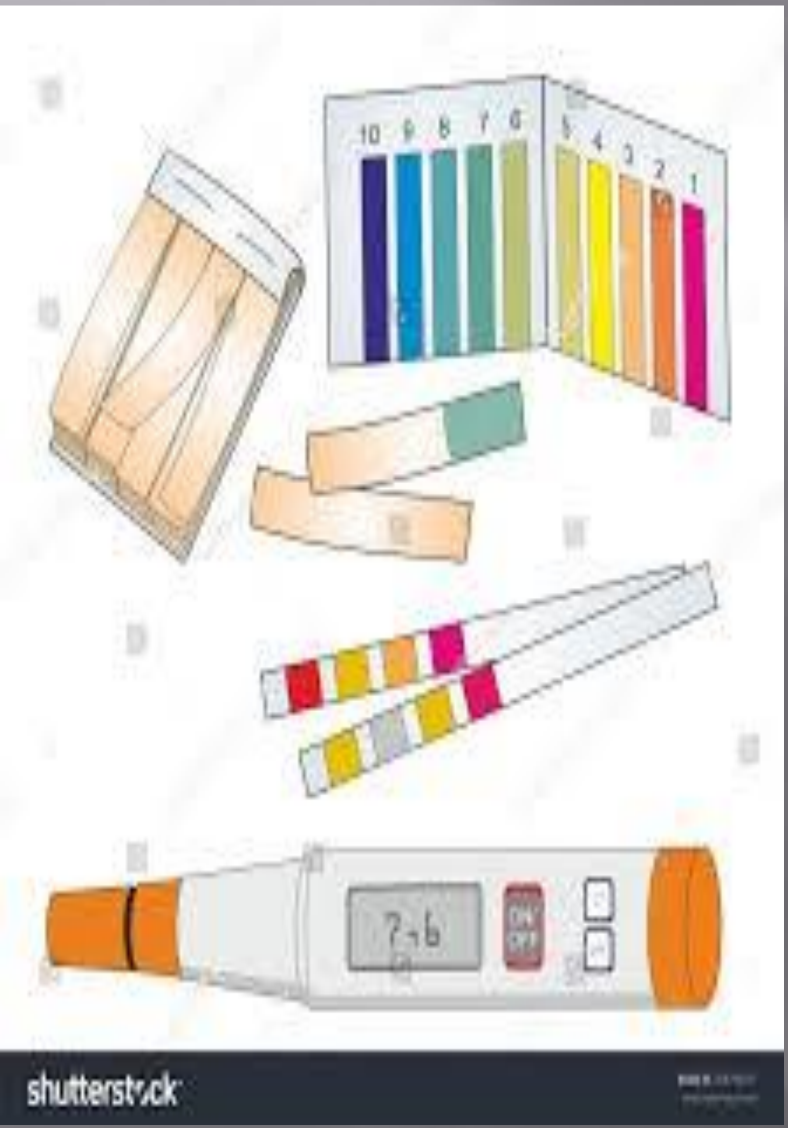
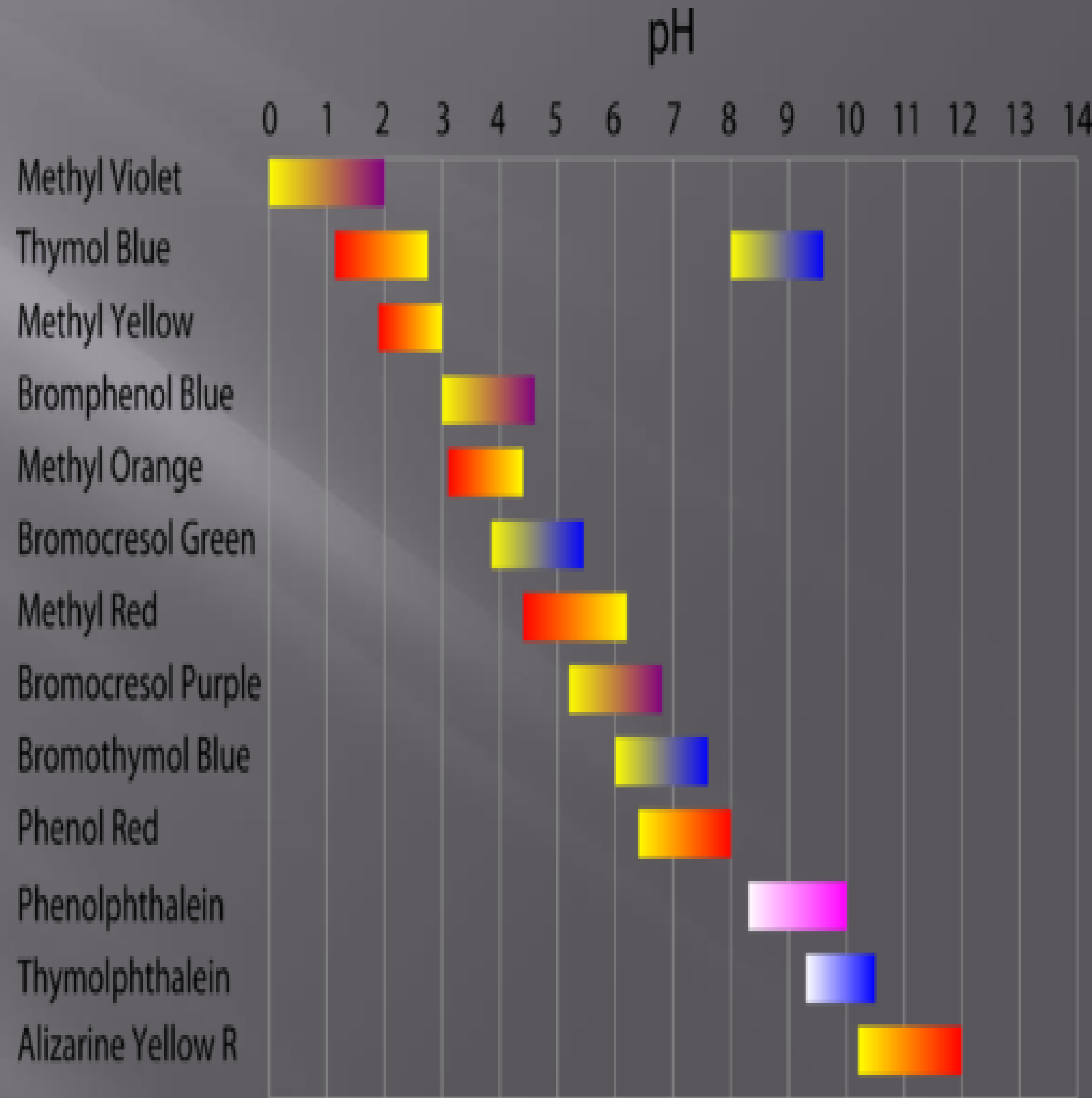
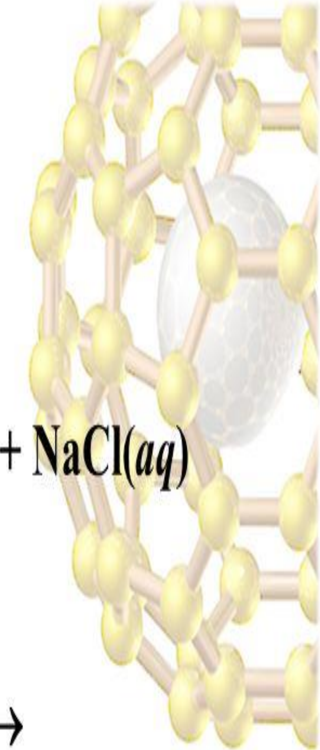




POINTS TO PONDER:

Acids, Bases, and Salts



Neutralization Reaction

$$HCl(aq) + NaOH(aq) \rightarrow H_2O(l) + NaCl(aq)$$

Total Ionic Equation

$$H^+(aq) + Cl^-(aq) + Na^+(aq) + OH^-(aq) \rightarrow H_2O(l) + Na^+(aq) + Cl^-(aq)$$

Net Ionic Equation

$$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$$

hydrolysis

$$NaCl + H_2O \rightarrow (Na^+ OH^-) + (H^+ Cl^-)$$

pH = 7

sodium chloride

salt

sodium hydroxide

strong base

hydrochloric acid

strong acid

POINTS TO PONDER:

Chapter 10

Acids, Bases and Salts

Examples of Salts

Table 1

Base (alkali)	Acid	Salt formed
Sodium hydroxide	Hydrochloric acid	Sodium chloride
Potassium hydroxide	Hydrochloric acid	Potassium chloride
Sodium hydroxide	Sulphuric acid	Sodium sulphate
Potassium hydroxide	Sulphuric acid	Potassium sulphate
Calcium hydroxide	Nitric acid	Calcium nitrate
Ammonia solution	Nitric acid	Ammonium nitrate

SALTS:

What type of reaction?

$HCl + NaOH \rightarrow H_2O + NaCl$

- A **neutralization** reaction is the reaction between an **acid** and a **base** to produce a **salt** plus **water**.
- A **salt** is any compound containing the **cation** of a base and an **anion** from an acid.
  - NaOH (base) -- Na^+ cation
  - HCL (acid) -- Cl^- anion
  - SALT -- NaCl

1) SODIUM CHLORIDE NaCl

$$NaCl + HOH <=> \underset{\text{strong base}}{NaOH} + \underset{\text{strong acid}}{HCl}$$

$$\cancel{Na^+} + \cancel{Cl^-} + HOH <=> \cancel{Na^+} + OH^- + H^+ + \cancel{Cl^-}$$

$$HOH <=> \boxed{OH^-} + \boxed{H^+}$$

(neutral medium, pH=7)

In solution strong base and strong acid are dissociated completely. The salt solution is neutral. **No hydrolysis.**

Making salts

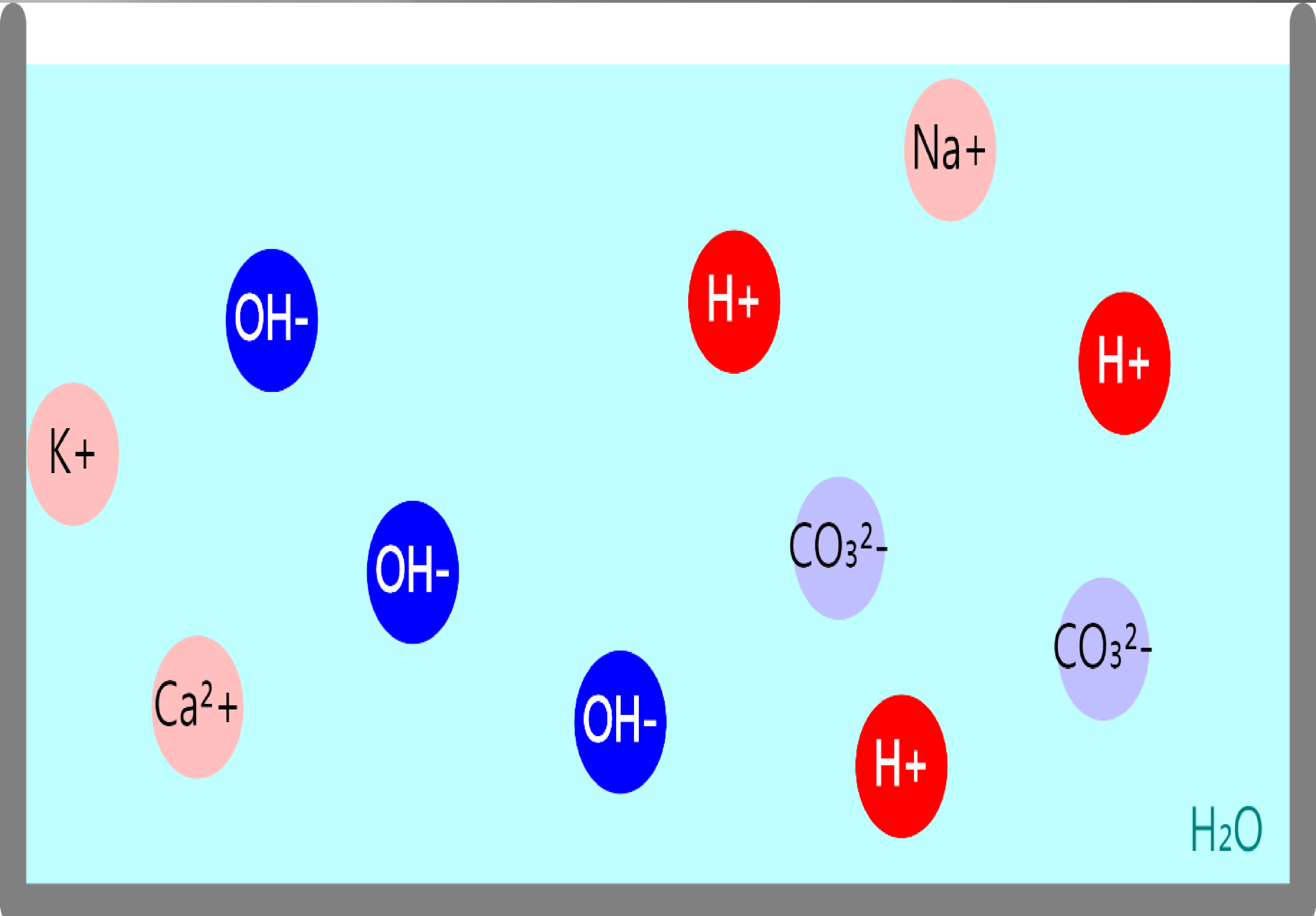
The salt produced by a neutralization reaction depends on the acid and the alkali used.

Sodium chloride is produced by the reaction between hydrochloric acid and sodium hydroxide.

hydrochloric acid + sodium hydroxide → sodium chloride + water

Which acid and which alkali would be needed to make the salt potassium chloride?

hydrochloric acid + potassium hydroxide → potassium chloride + water



Na+
OH-
H+
H+
K+
OH-
CO3 2-
CO3 2-
Ca2+
OH-
H+
H2O

Neutralization

During a **neutralization reaction**, an acid and a base react to produce a salt and water. Salts are ionic compounds consisting of an **anion from an acid** and a **cation from a base**.

$$HCl_{(aq)} + NaOH_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$$

$$H_2SO_{4(aq)} + 2NaOH_{(aq)} \rightarrow Na_2SO_{4(aq)} + 2H_2O_{(l)}$$

$$2HCl_{(aq)} + Ca(OH)_{2(aq)} \rightarrow CaCl_{2(aq)} + 2H_2O_{(l)}$$

Neutralization

Acid-Base Neutralization

Acid + Base ---> a Salt + Water

$H_2SO_4 + 2NaOH \text{ ---> } Na_2SO_4 + 2H_2O$

Ionic Equations show the predominant reacting species.

$$H^+_{(aq)} + OH^-_{(aq)} \rightleftharpoons H_2O_{(l)} + 13\ \text{Kcal/mol}$$

Strength of Acids, the Equilibrium Constant:

$$HA \rightleftharpoons H^+_{(aq)} + A^-_{(aq)} \qquad K = \frac{[H^+][A^-]}{[HA]}$$

A large K means a strong acid. It's highly ionized.

A Salt is a compound derived from the reaction of an acid plus a base. Or from ions from opposite sides of the periodic chart.

SELF-ASSESSMENT 10.5:

- $Mg(OH)_2 + HCl \rightarrow MgCl_2 + H_2O$
- $KOH + HCl \rightarrow KCl + H_2O$
- BALANCE THE FOLLOWING NEUTRALIZATION REACTIONS:(i)$H_2SO_4 + NaOH \rightarrow Na_2SO_4 + H_2O$
- (ii)$H_3PO_4 + NaOH \rightarrow Na_3PO_4 + H_2O$
- SELF ASSESSMENT 10.6:
- CLASSIFY THE FOLLOWING SALTS AS NORMAL OR ACID SALT
- $NaHCO_3$,$NaHSO_4$,Na_2SO_4,$KHCO_3$,K_2CO_3.

Today's Learning

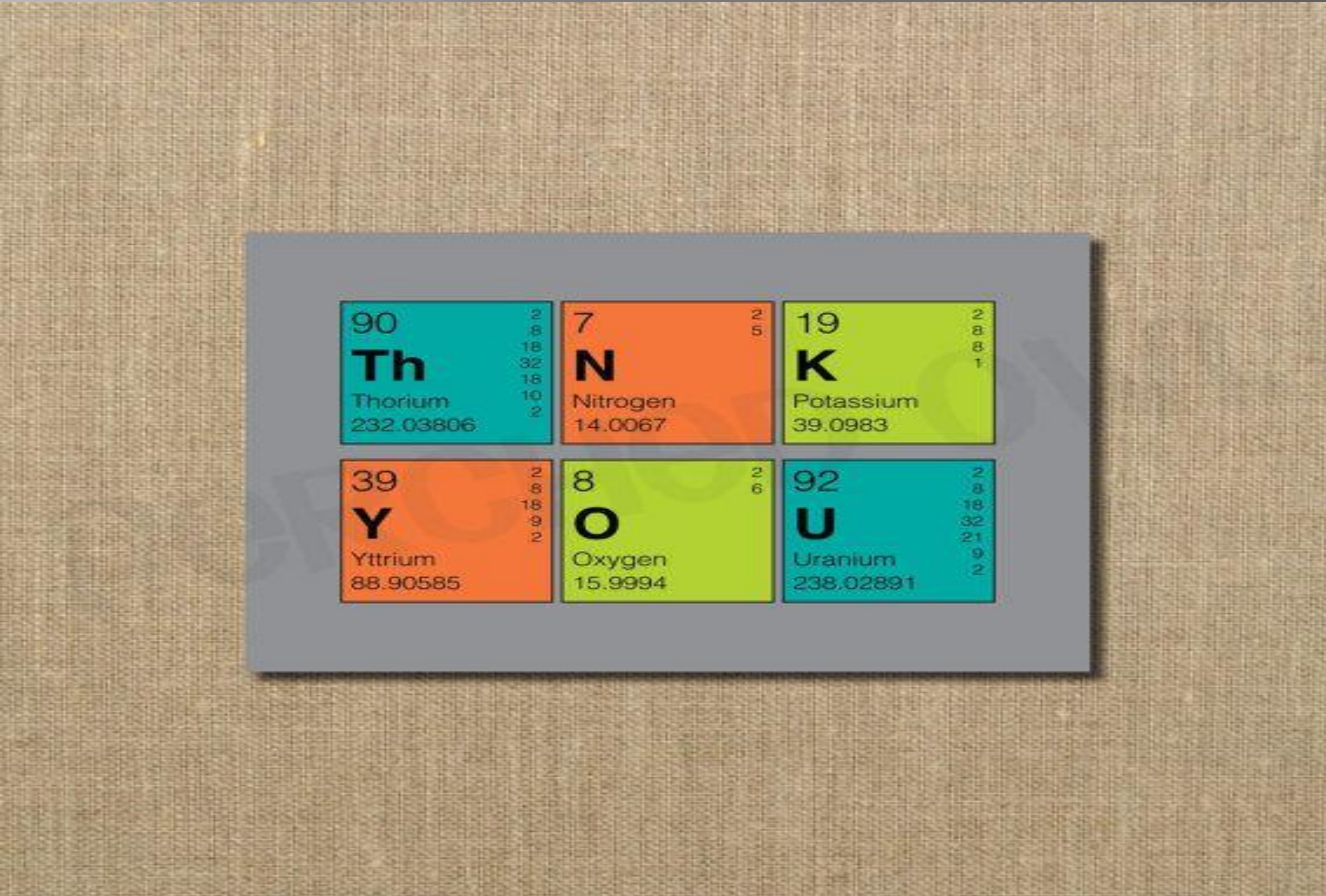
Don't forget to put your name on!

Something I can do now that I couldn't do before the lesson is…	A question I would like to know the answer to is…	I need to improve on…

HOME-WORK:

- **<u>Homework:</u>**
- **<u>DO ANY ONE QUESTION:</u>**
- **EXPLAIN SELF-IONIZATION OF WATER?**
- **DERIVE THE Kw OF WATER?**
- **WHAT IS pH ?WRITE THE IMPORTANCE OF Kw?**
- **EXPLAIN pHscale?**
- **DEFINE SALT?HOW IT IS PREPARED?**
- **DEFINE NEUTRALIZATION?**

CLOSURE OF THE LESSON: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7 N Nitrogen 14.0067 2 5
19 K Potassium 39.0983 2 8 8 1
39 Y Yttrium 88.90585 2 8 18 9 2
8 O Oxygen 15.9994 2 6
92 U Uranium 238.02891 2 8 18 32 21 9 2


THANK YOU


good bye
good bye
SCHOOL BUS