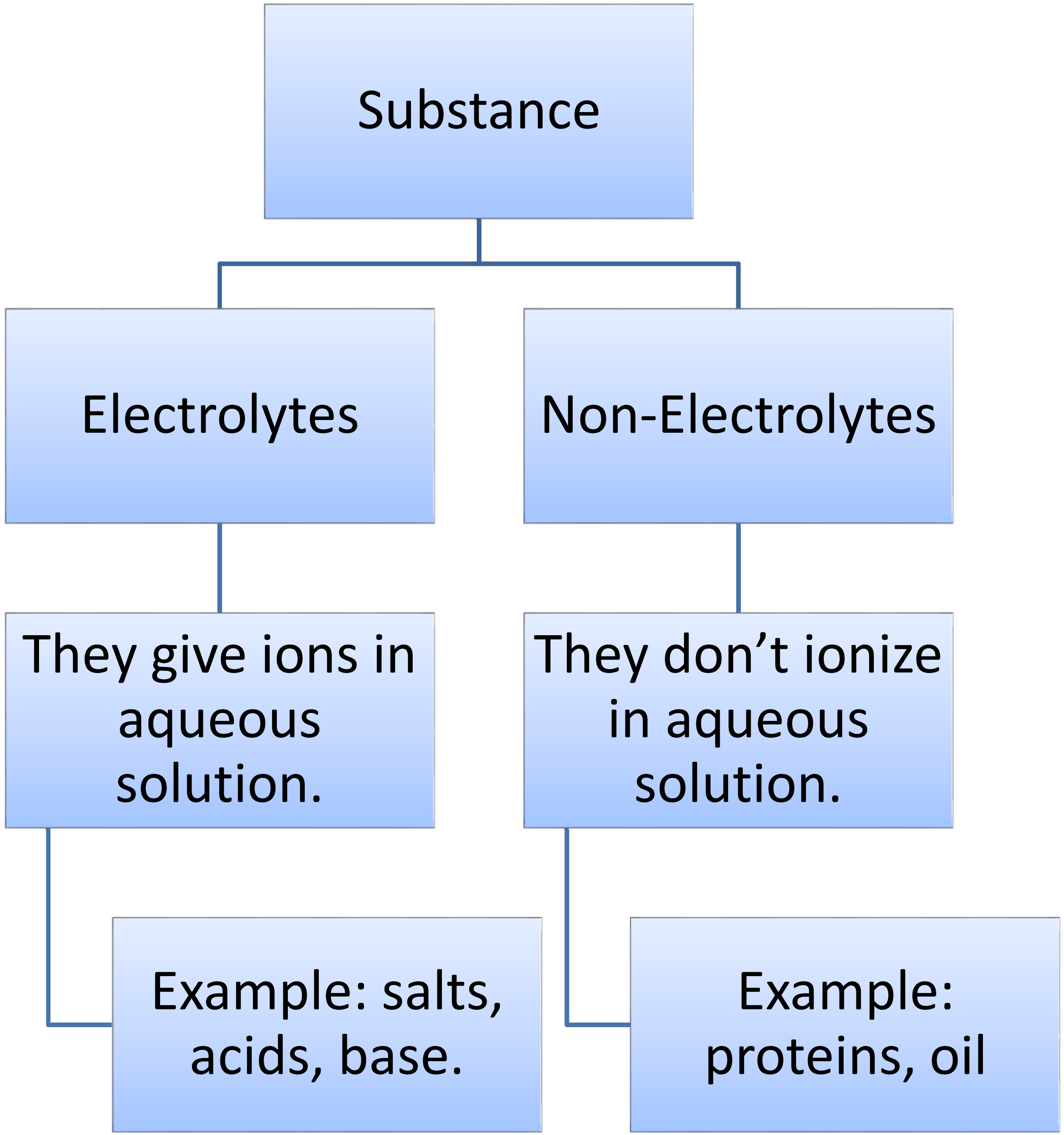
pH measurements


Substance
Electrolytes
Non-Electrolytes
They give ions in aqueous solution.
They don’t ionize in aqueous solution.
Example: salts, acids, base.
Example: proteins, oil

Electrolytes

Strong electrolytes: completely ionized

Examples:

$NaCl \longrightarrow Na^{+} + Cl^{-}$

$HCL \longrightarrow H^{+} + Cl^{-}$

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

Weak electrolytes: partially ionized

Examples:

$CH_3COOH \leftrightarrow CH_3COO^{-} + H^{+}$

$NH_4OH \longleftrightarrow NH_4^{+} + OH^{-}$

Ionic product of water

- Water has the ability to break up a substance into ions.
- The water molecules themselves can also break up into $[H^+]$ and $[OH^-]$ ions although only to a very small extent (very low concentration of dissociated substance).

$$H2O \leftrightarrow H^{+} + OH^{-}$$

Ionic product of water

- The concentration of $[H^+]$ and $[OH^-]$ is very small and found that it equals 1×10^{-14} mol^2/dm^6 at 25^oC.
- The water is considered to be neutral so the concentration of $[H^+]$ is equal to$[OH^-]$.
- So the conc. of $[H^+] = 10^{-7}$ $mole/dm^3$ and the conc. of $[OH^-] = 10^{-7}$ $mole/dm^3$
- $[H^+] = [OH^-] = 10^{-7}$ $mole/dm^3$ in a pure water.

Ionic product of water

- ionic product of pure water K_w:
- $Kw = [H^+] * [OH^-] = [10^{-7}] * [10^{-7}] = 10^{-14}$
- $-Log(K_w) = -Log([H^+]*[OH^-])$
- $-Log(K_w) = -Log[H^+] - Log[OH^-]$
- $pK_w = pH + pOH$
- $-Log(10^{-14}) = -Log[10^{-7}] – Log[10^{-7}]$
- 14 = 7 + 7

Acid Solutions

- An acid when added to water will donate H^+ ions to the water.
- This means that the $[H^+]$ of the water will increase.
- The $[H^+]$ and $[OH^-]$ will no longer be equal.
- Although the $[H^+]$ has increased K_w always remains the same at 10^{-14} mol^2/dm^6. Therefore the $[OH^-]$ will decrease.

Acid Solutions

- In any acid solution the $[H^+] > [OH^-]$

$[H^+] > 10^{-7}$ mole/dm^3

pH < 7

$[OH^-] < 10^{-7}$ mole/dm^3

pOH > 7

Alkaline Solutions

- A base when added to water will donate OH^- ions to the water.

- This means that the $[OH^-]$ will increase.

- the $[H^+]$ and $[OH^-]$ will no longer be equal.

Alkaline Solutions

- In any basic solution the $[H^+] < [OH^-]$

$[H^+] < 10^{-7}$ mole/dm^3

pH > 7

$[OH^-] > 10^{-7}$ mole/dm^3

pOH < 7

Neutral Solutions

- $[H^+] = [OH^-]$
- $[H^+] = 10^{-7}$ mole/dm^3
- **pH = 7**
- $[OH^-] = 10^{-7}$ mole/dm^3
- **pOH = pH = 7**

[H+]scale

10^{-0}-------------------------10^{-7}---------------------10^{-14}

Acid (acidic range) Neutral (basic range)Base

pH scale:

0---------------7----------------14

Acid Neutral Base

- As the pH decreases, the acidity increases and $[H^+]$ions increases.

- **Example(1) :**
- Calculate the pH of 0.1M $Ca(OH)_2$?
- **Solution:**
- $Ca(OH)_2 \longrightarrow Ca^{2+} + 2OH^-$
- 0.1 M 0.1M 2*0.1
- pOH = -Log(OH^-)
- pOH = -Log(0.2) = 0.69
- pH = 14 – pOH = 14 – 0.69 = 13.31
- **pH = 13.3**

- **Example(2):**
- Calculate the pH of 0.2N H_2SO_4?
- **Solution:**
- **Molarity = Normality / valency**
- Molarity = 0.2/2 = 0.1 M
- $H_2SO_4 \longrightarrow 2H^+ + SO_4^{2-}$
- 0.1 M 2*0.1M 0.1M
- pH = -Log(H^+)
- pH = -1 * Log(0.2) = 0.7
- pH = 0.7

Buffer solution

- **Definition:** It's a solution that resists the change in pH when a small amount of strong acid or strong base is added.
- Buffer solution regulates the change in pH.
- Buffer solution classified into acidic and basic buffer solution.

Acidic buffer solution

- Its pH<7 and consists of weak acid and its salt.
- **Example :**
  - Acetic acid (CH_3COOH) + sodium acetate (CH_3COONa)

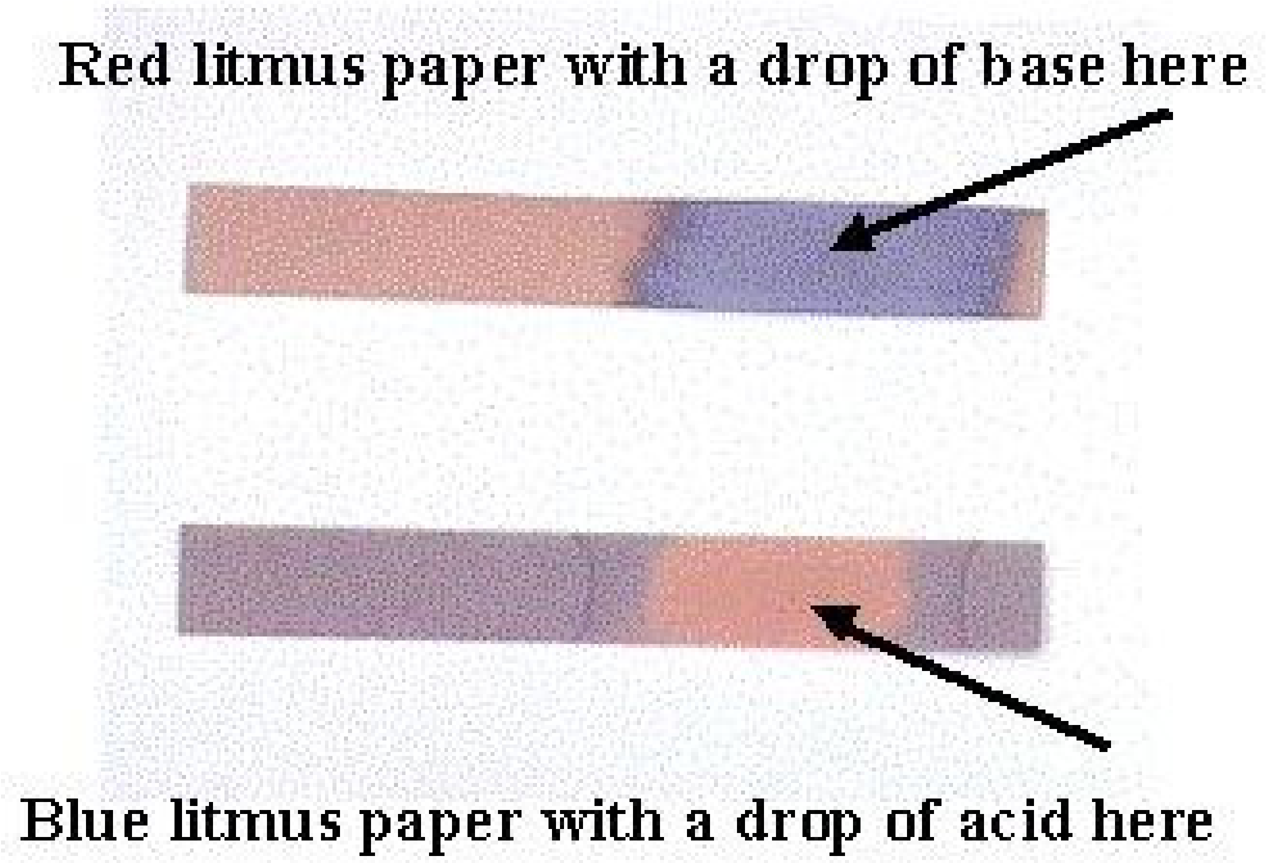
Basic buffer solution

- Its pH>7 and consists of weak base and its salt.
- **Example :**
  - Ammonium hydroxide (NH_4OH) + ammonium chloride (NH_4Cl)

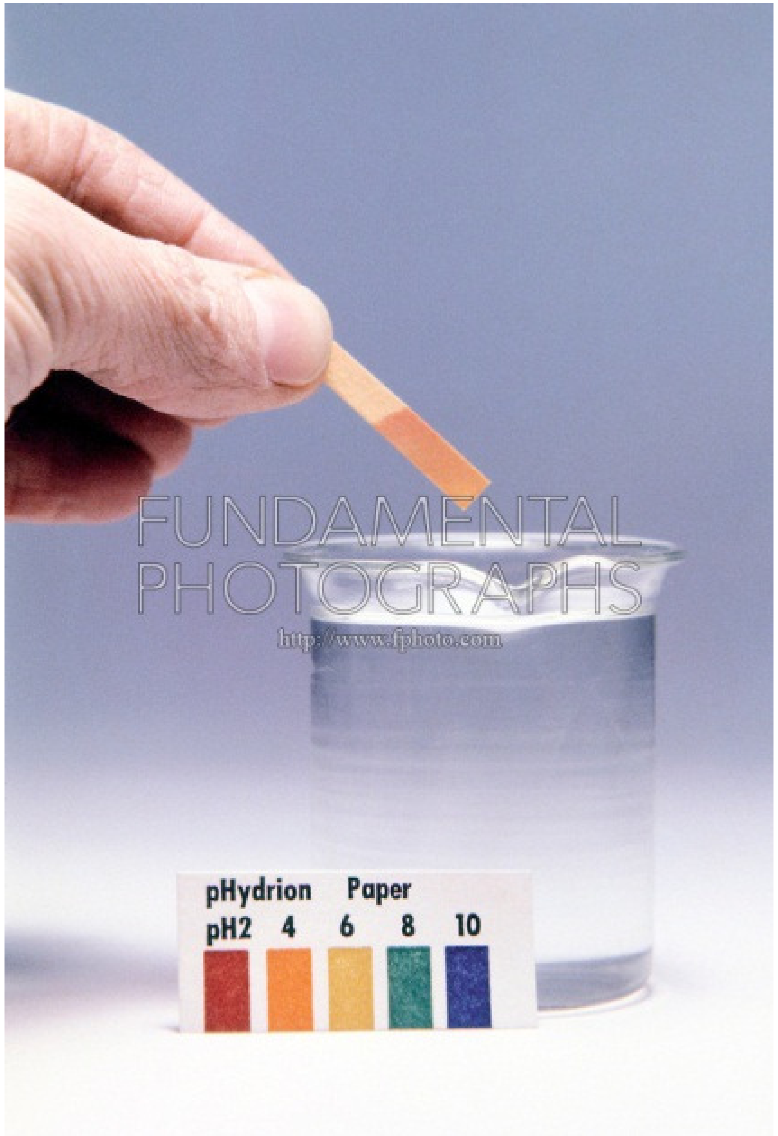
pH measurement

- **Definition:** The term used to measure the acidity of the solution.
- **Examples:**
  1. Litmus paper.
  2. pH paper.
  3. Indicators.
  4. pH meter.

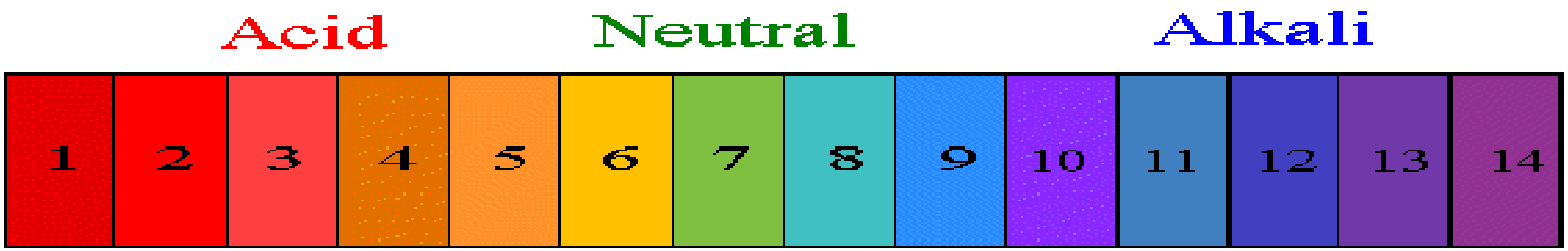
1- litmus paper



2- pH paper


FUNDAMENTAL
PHOTOGRAPHS
http://www.fphoto.com
pHydrion Paper
pH2 4 6 8 10

3- pH indicators



4- pH meter

DENVER INSTRUMENT
5.98
UltraBASIC
CORNING Stirrer
power
stir

Thank you

☺