# Principles of pH meter

Purpose of the experiment : The determination of pH value for three differently mixed volume buffer solutions of acetic acid and lead acetates.

Theory

A pH meter is a device that measures the pH of a solution by measuring the voltage between two electrodes submerged in the solution.
A pH meter is used to determine the acidity or alkalinity of the solution.

pH is the concentration of hydrogen ions in the solution. A solution containing more H^+ ions remains acidic while the solution containing more OH^- ions remains alkaline. pH value of solutions ranges from 1 to 14.
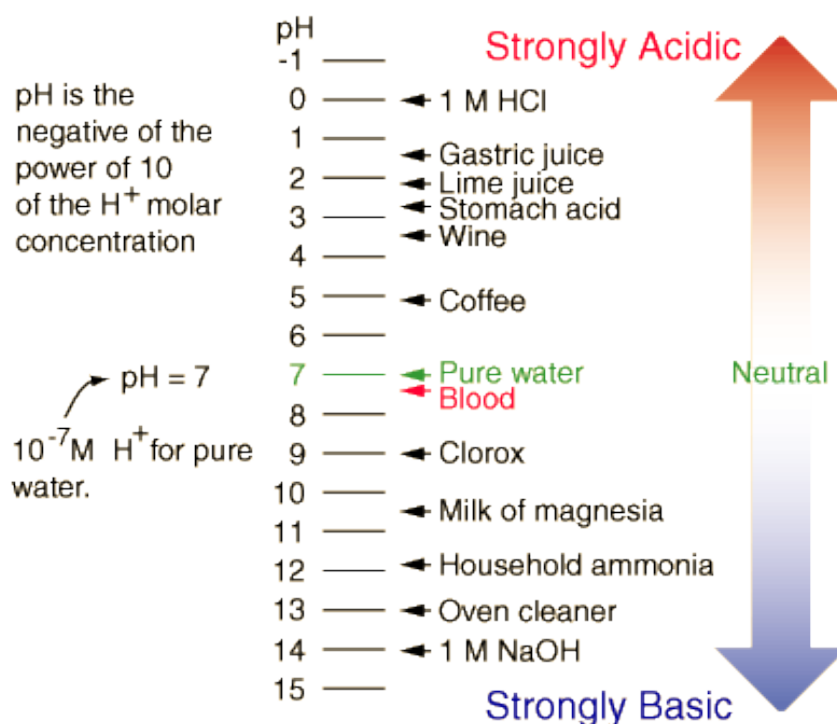
The formal definition of pH :

$$pH = -log^{[H+]}$$

Represent the logarithmic function of the concentration of H^+ ions which express the reciprocal potential of hydrogen concentration on both sides of the bulb membrane. The pH value of a neutral solution equal to 7 according to the following example:

If $[H^+] = 10^{-10}$ means that hydrogen concentration is low. It means that pH value = 10 so that the solution is alkaline.

But when $[H^+] = 10^{-3}$ means that hydrogen concentration is high. It means that pH value = 3 so that the solution is acidic.

A pH electrode is composed of two main parts :

1. A glass electrode is a type of ion-selective electrode made of a doped glass membrane that is sensitive to a specific ion.

2. A reference electrode is an electrode which has a stable and well-known electrode potential.

Parts of glass electrode :

1. Glass bulb (glass membrane the sensitive part).
2. Ag/AgCl electrode.
3. 0.1 KCl solution (glass electrode internal filling solution pH =7).
4. AgCl precipitated from glass electrode.
5. Ag/AgCl electrode or calomel electrode.
6. 0.1 KCl solution (reference electrode internal filling solution pH =7).
7. Junction made of ceramic or capillary with asbestos or quartz fibre (used to electrically connect both measured solution and the internal filling solutions.
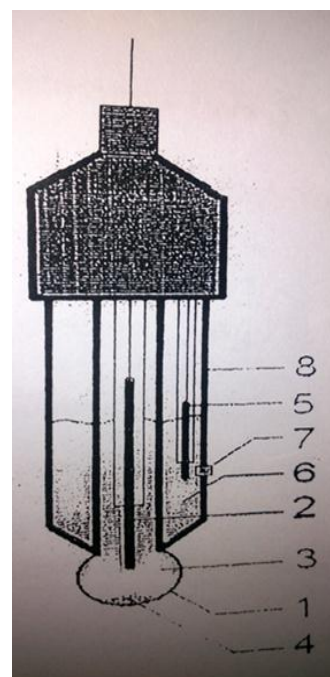
Buffer solutions:

Is an aqueous solution consisting of a mixture of a weak acid and its conjugate base, or vice versa. Its pH changes very little when a small or moderate amount of strong acid or base is added to it and thus it is used to prevent changes in the pH of a solution. Buffer solutions are used as a means of keeping pH at a nearly constant value in a wide variety of chemical applications. for Example: Bicarbonate buffer is a mixture of carbonic acid (the weak acid) and the bicarbonate ion (the conjugate base): $H_2CO_3 + HCO_3^-$

$$pH = log\ pKa + log\ salt/\ acid$$

Procedure:

1. Prepare acetic acid-acetate buffer solutions according to the following table:

pH	Vol. of 0.1 M acetic acid solution	Vol. of lead acetate solution
3	16.94 ml	3.06 ml
4	7.14 ml	12.86 ml
5	1.044 ml	18.956 ml

2. Mix the above volumes in three beakers and measure pH value by pH meter.

Questions:

1- What is pH-meter? Explain its parts.

2- Define reference electrode, glass electrode, buffer solution , pH ?.