Determination of pH in some Water Samples

Introduction:

An acid/base titration can be monitored with an indicator or with a pH meter. In either case, the goal is to determine the equivalence point of the titration. This is the point at which enough titrant has been added to the analyte to just exactly neutralize the analyte. In this experiment, knowledge of the equivalence point will be used to obtain information about the acid dissociation constant, Ka, of the acid being titrated. When an indicator is used in a titration, the color change occurs at what is called the endpoint. If the indicator has been properly selected, this point will be the same as the equivalence point. When a pH meter is used, the pH of the solution is recorded as the titrant is added. The pH versus the volume of titrant added can be plotted on what is called a titration curve. In this case the equivalence point occurs at the point where very small additions of titrant cause a very rapid rise in the pH. Graphically, it is also the point on the curve where the slope, $\Delta pH/\Delta V$, changes from positive to negative (called the inflection point.).

What is/are:

Acid?

Base?

Types of Acid & Base?

Acid-Base Reaction General Equation?

Acid-Base Titration?

Equivalence Point?

Oxidation & Reduction?

Electro Chemistry?

Electrochemical Cell?

Indicator & Reference Electrode?

Electrode Potential?

Glass Electrode?

pH (Combination) Electrode?

pH range?

Acid:

An ***acid*** is a substance that generates hydronium ions, H_3O^+ (often described as H^+), when added to water.

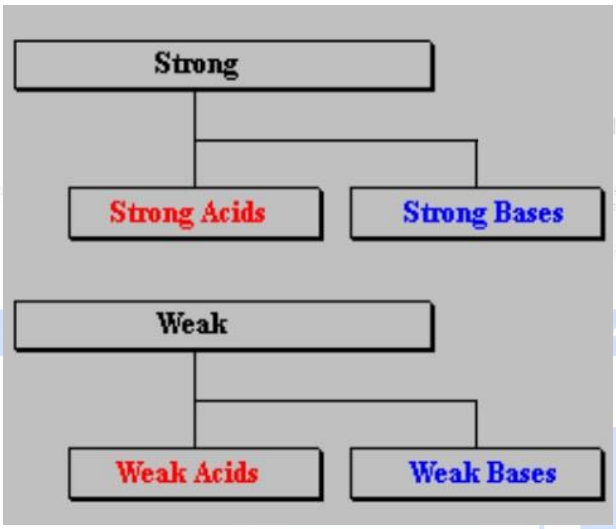
An ***acidic solution*** is a solution with a significant concentration of H_3O^+ ions.

Base:

A ***base*** is a substance that generates OH^- when added to water.

A ***basic*** solution is a solution with a significant concentration of OH^- ions.

Types of Acids and Bases:



Acid-Base Reaction General Equation:

$$\underset{\text{acid}}{HX(aq)} + \underset{\text{base}}{MOH(aq)} \rightarrow \underset{\text{water}}{H_2O(l)} + \underset{\text{salt}}{MX}$$

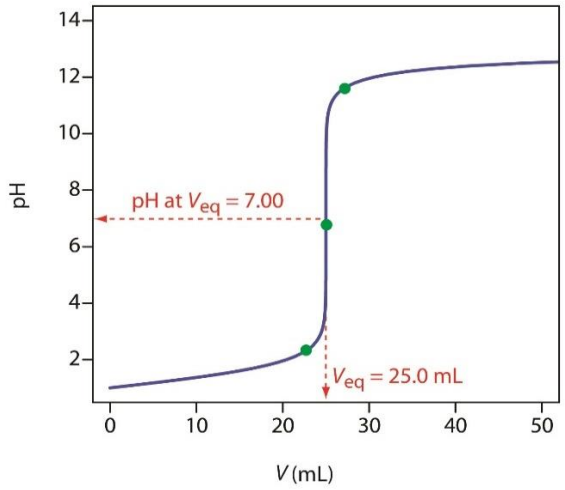
Acid-Base Titration:

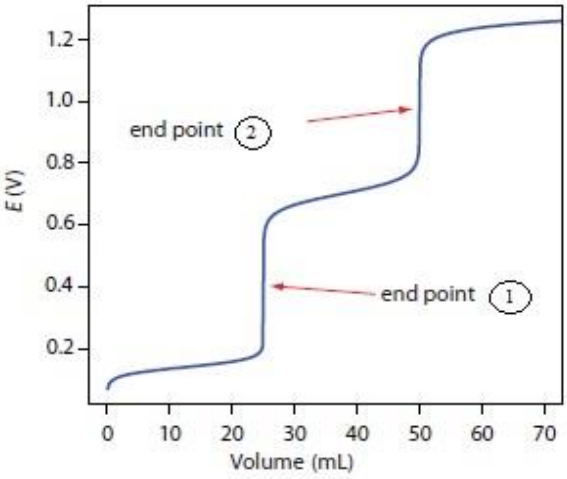
Acid-Base Titration

- Carefully controlled neutralization reaction.
- Requires a standard solution and an acid-base indicator.
- Standard solution has an acid or base of known concentration.

Equivalence point:

- Total number of moles of H^+ ions donated by acid = total number of moles of H^+ accepted by base.
- Total moles H^+ = total moles OH^-





Reduction:

Gain of Electrons is Reduction (GER)

$$Cl + e^- \longrightarrow Cl^-$$

Negative charge represents electron richness

ONE NEGATIVE CHARGE MEANS RICH BY ONE ELECTRON

Reduction occurs at the cathode

Oxidation:

Loss of Electrons is Oxidation (LEO)

$$Na \longrightarrow Na^+ + e^-$$

Positive charge represents electron deficiency

ONE POSITIVE CHARGE MEANS DEFICIENT BY ONE ELECTRON

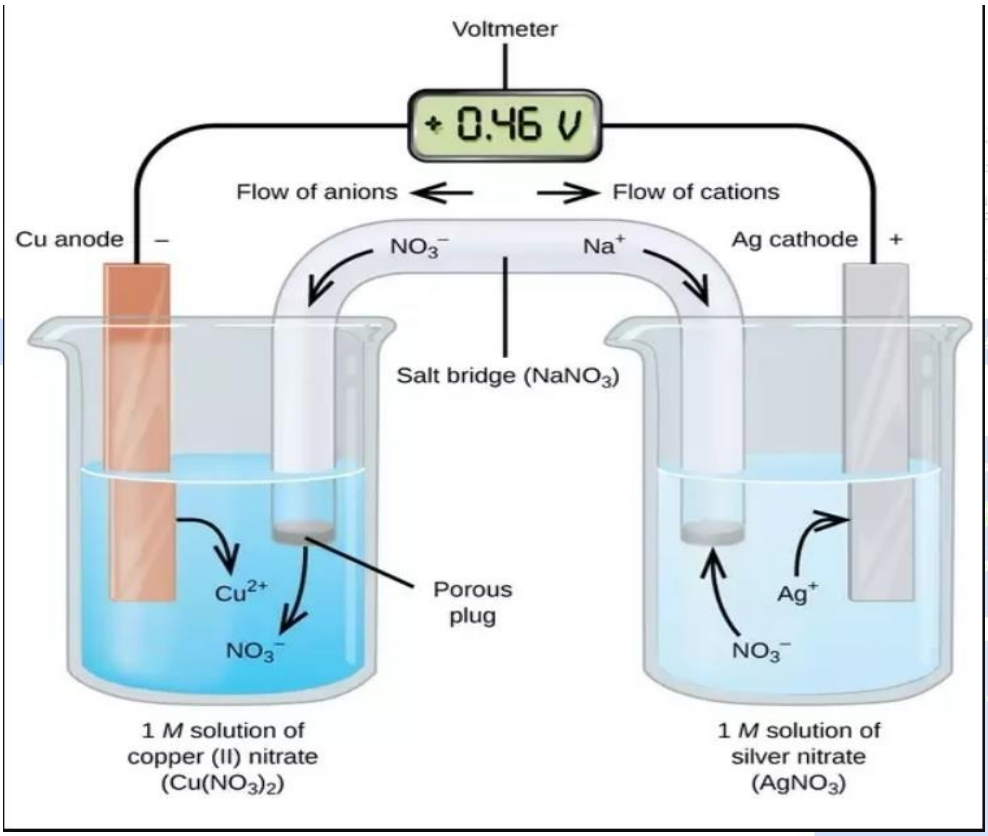
Oxidation occurs at the Anode

Electro Chemistry:

A study of chemical changes produced by electric current and with the production of electricity by chemical reactions.

All electrochemical reactions involve the transfer of electrons and are therefore oxidation-reduction reactions.

Electrochemical Cell:



Indicator & Reference Electrode:

Reference Electrode

1. Standard Hydrogen electrode
2. Calomel electrode
3. Silver-Silver Chloride electrode

Indicator Electrode

1. Metal Electrode
2. Hydrogen electrode
3. Quinhydrone electrode
4. Glass Membrane Electrode

Electrode Potential:

Standard Potential

Potential of pure metal when it is dipped in 1 Molar solution of its own ions at 25°C (298K) is known as standard Electrode potential.

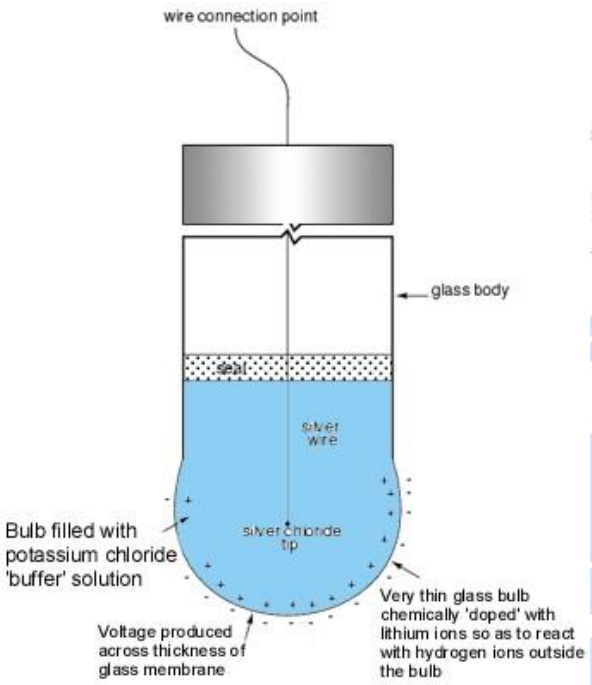
Oxidation Potential

The potential of substance to get oxidized is called oxidation potential.

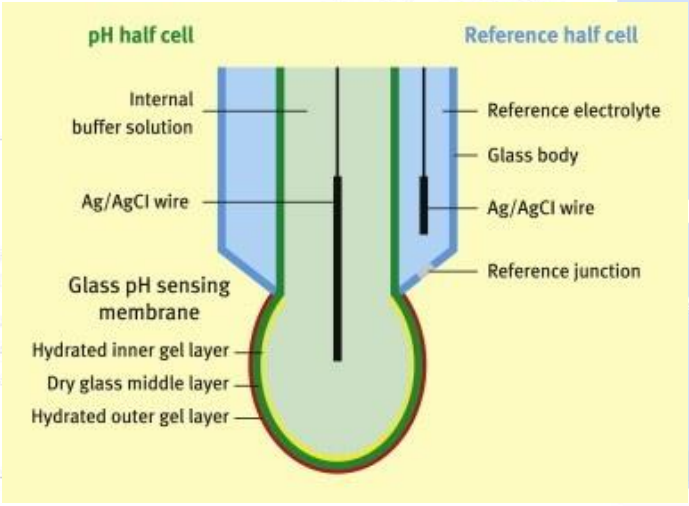
Reduction Potential

The potential of substance to get reduced is called reduction potential.

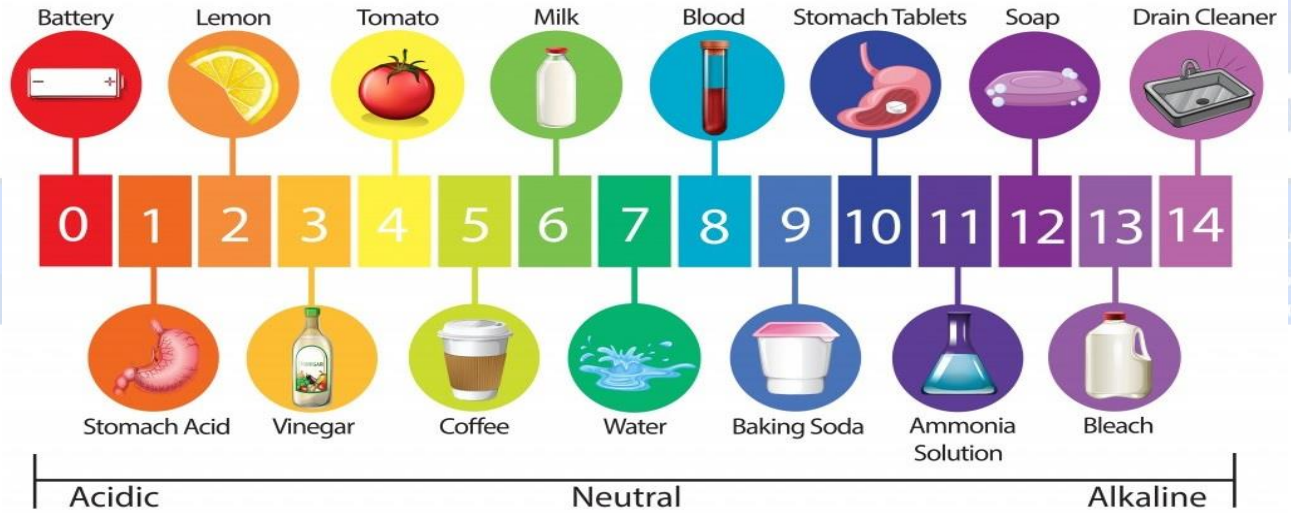
Glass Electrode:



pH (Combination) Electrode:



pH Range:

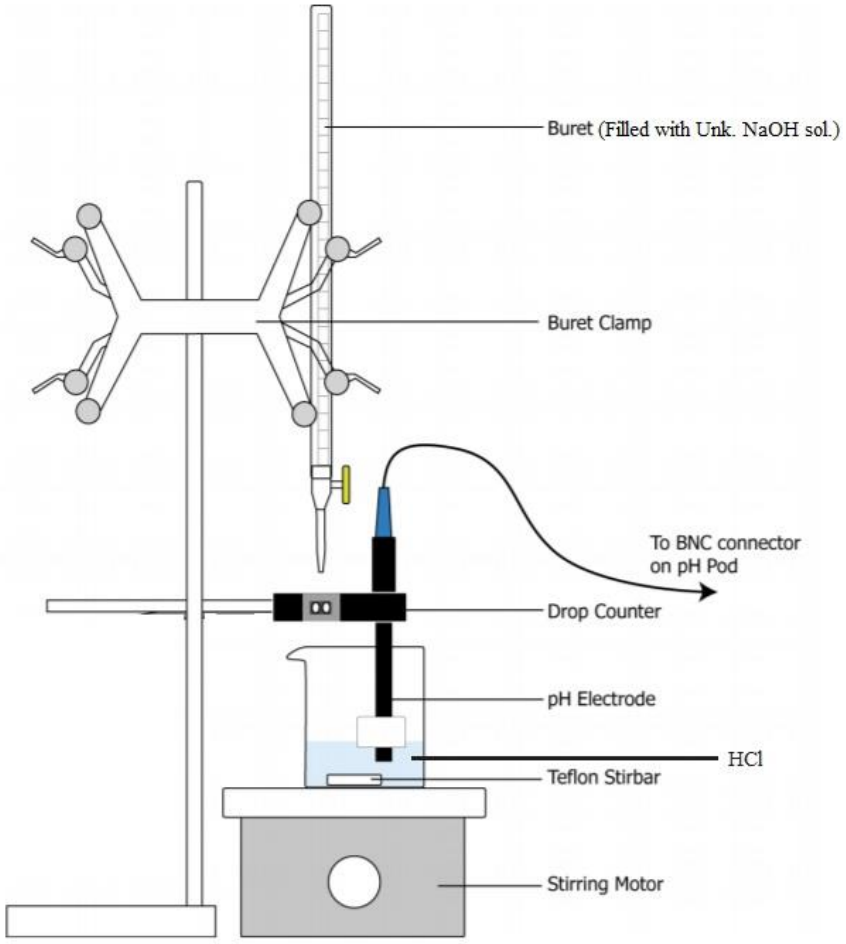


Experimental:

1- Plug in the pH meter to power source and let it warm up for 5 to 10 minutes.

2- Wash the glass electrode with distilled water and clean slowly with a soft tissue.

3- Construct the system as shown in the photo below:



4- Place the electrode in pH 10 buffer solution and Calirbate the value of 10 on the pH meter.

5- Take out the electrode, wash it with distilled water and clean it up.

6- Repeat step (4) with pH 7 & 4 Buffer solutions, Then step (5).

7- Now place the electrode in the water sample which pH is to be determined.

8- Repeat step (6) with all Water Samples.

9- Wash the Electrode and Turn off the Instrument.

Results:

No	Buffers & Samples	pH Value
1	Buffer 1 (pH 10)	≈10
2	Buffer 2 (pH 7)	≈7
3	Buffer 3 (pH 4)	≈4
4	Bottled Water	pH_1
5	Uni. Water	pH_2
6	Student's Sample (1)	pH_3
7	Student's Sample (2)	pH_4
8	Student's Sample (3)	pH_5

Titration Graph: