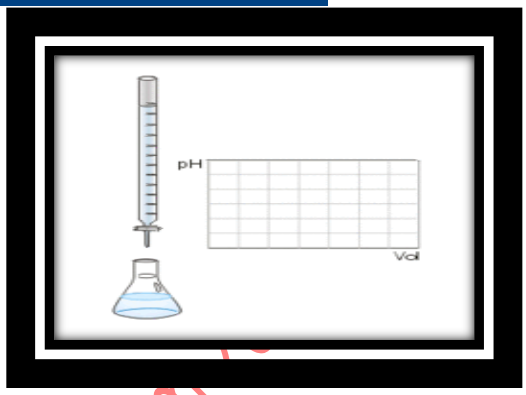
Lect.4.

Titration

Neutralization Reaction& Definition, Equation



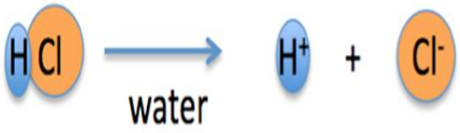
Neutralization is a type of chemical reaction in which a strong acid and strong base react with each other to form water and salt.

For example: acid + base → salt + water

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

$HCl(aq) \rightarrow H^+(aq) + Cl^-(aq)$

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



Dissociation of a Strong Electrolyte in Water

Have you ever been unlucky enough to be stung by a wasp or a bee? Bee stings are acidic in nature, which is why a household remedy for a bee sting is baking soda or sodium bicarbonate, which is a basic substance. A wasp sting, on the other hand, is mildly basic, so a household remedy for this will be vinegar, also known as acetic acid. These simple treatments ease these painful stings by a process called neutralization. Heartburn, as well as an acidic stomach due to eating too much spicy food, can be relieved by taking an antacid. The antacid is alkaline/basic and helps neutralize the stomach's acidic environment. You may have used medicine to ease your heartburn via the process of neutralization.

Lect.4.

Stomach Antacids:

Antacids are supposed to decrease the amount of hydrochloric acid in the stomach by reacting with excess acid. They are used in the treatment of gastric hyperacidity and peptic ulcers. Some of the ingredients in antacids are: Magnesia (MgO), milk of magnesia (Mg(OH)2, calcium carbonate (CaCO3), sodium bicarbonate (NaHCO3), dihydroxyaluminum sodium carbonate, (NaAl(OH)2CO3), aluminum hydroxide gel (Al(OH)3). Several of these will have to be recognized as Bronsted bases.

****

There are two types of neutralization reaction.

1-Strong acid & Strong base.

Strong Acids	Strong Bases
HCl	NaOH
HI	KOH
HBr	LiOH
$HClO_4$	CsOH
H_2SO_4	$Ba(OH)_2$

****

2-Weak acid & Weak base.

Weak Acids	Weak Bases
$HC_2H_3O_2$	NH_3
HF	NH_4OH
H_3PO_4	CH_3NH_2
H_2SO_3	$C_6H_5NH_2$
HClO	C_5H_5N

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Lect.4.

Titration

Acid and Base Titration is a quantitative analysis of concentration of an unknown acid or base solution.

Titration, also known as titrimetry, is a common laboratory method of quantitative chemical analysis.

The word "titration" comes from the Latin word *titulus*, meaning inscription or title. The French word *titre*, also from this origin, means rank.

Volumetric analysis originated in late 18th-century France

Titration defined : is the slow addition of one solution of a known concentration (called a titrant) to a known volume of another solution of unknown concentration until the reaction reaches neutralization, called which is often indicated by a color change (Titration).

The solution called the titrant must satisfy the necessary requirements to be a primary or secondary standard. In a broad sense, titration is a technique to determine the concentration of an unknown solution.

****

Equivalence point

The point at which a Neutralization reaction is complete is known called (Equivalence point).

****

Puepose of titration

1- Determine the concentration of an acid or a base.

2- Determine the equivalence point.

3- Determine the end point of reaction between acid and base.

****

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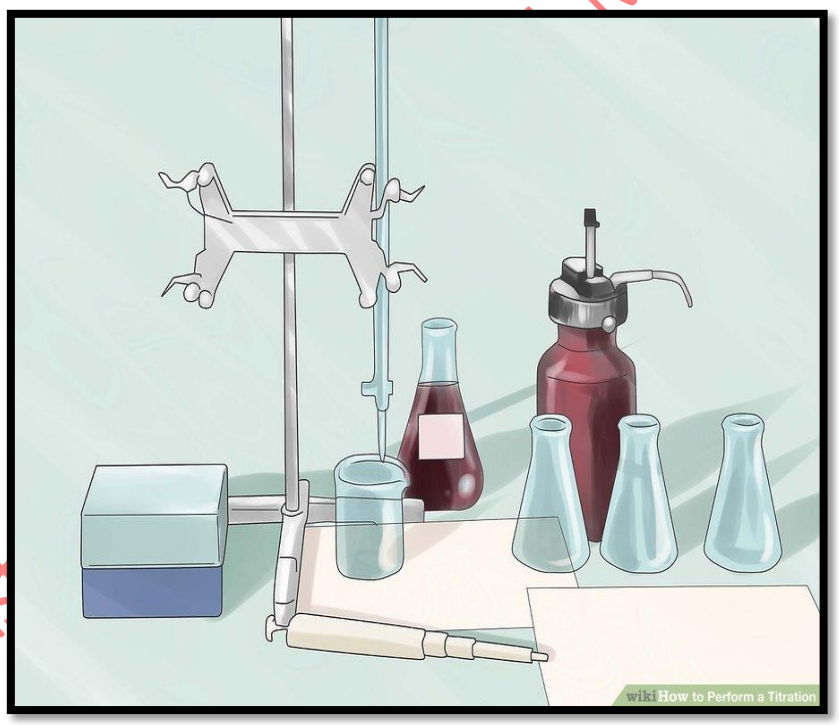
Titration equipment

1-Buret.
2-Flask.
3-Indicator .
4-pipet.
5-cylinder.
6-Beaker.
7-Funnel.

Step of titration

1- Obtain the items listed in the "Things You'll Need" section below.



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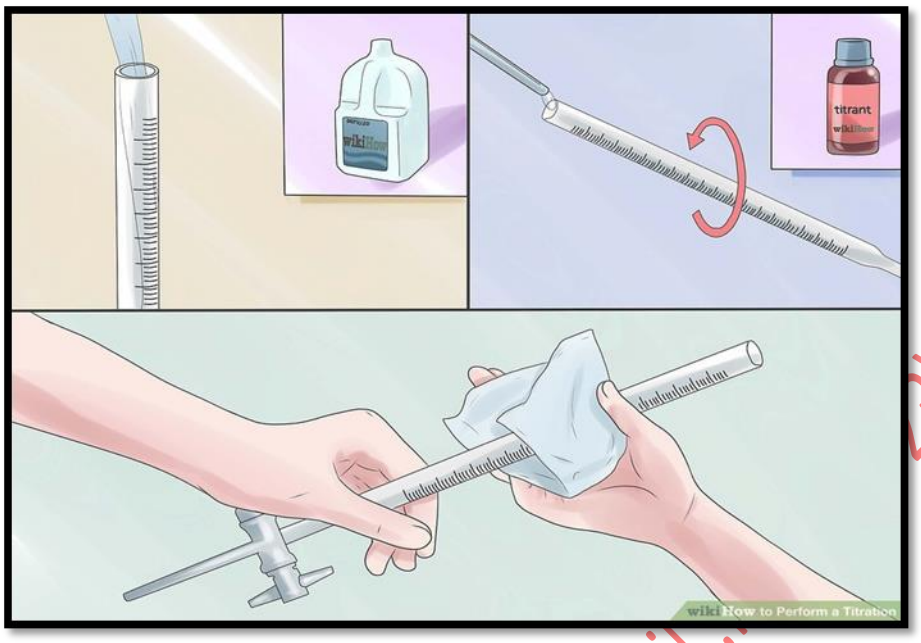
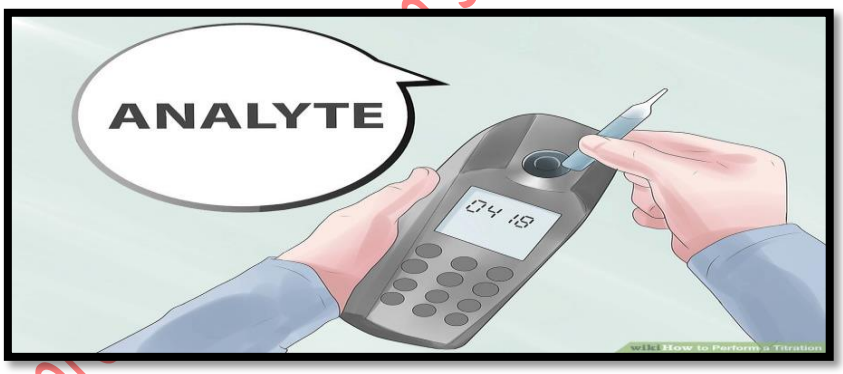
2-Rinse and purge your burette.



3- Clean and rinse all glassware with tap water (DI H2O if available is better), using some detergent if necessary. Be very careful with burettes, as they are very fragile. Always hold them with two hands.

4-Rinse all glassware with distilled water to lower the chances of contamination.

5- Measure out a precise amount of analyte (the reactant mixed in with the unknown).



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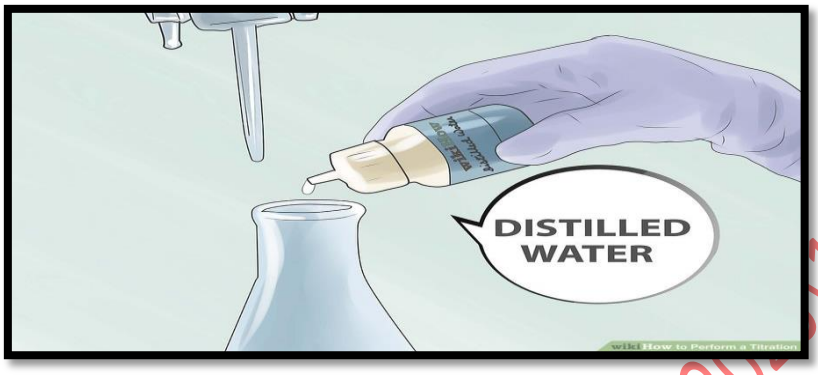
6-Fill your beaker or Erlenmeyer flask with a small amount of distilled water.



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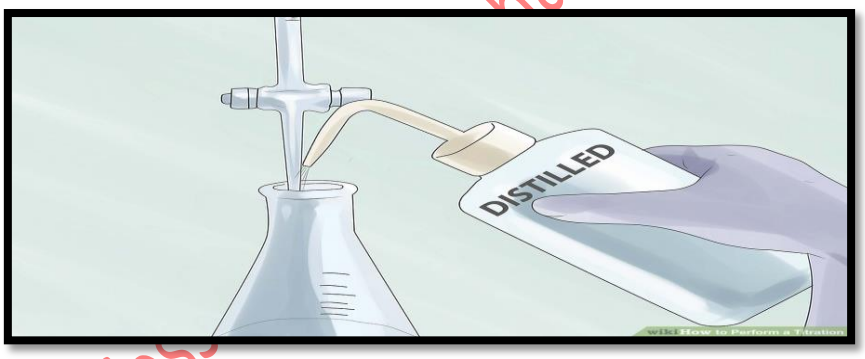
7-Rinse the analyte into your beaker or Erlenmeyer flask, thus making sure all of the analyte is in the beaker.



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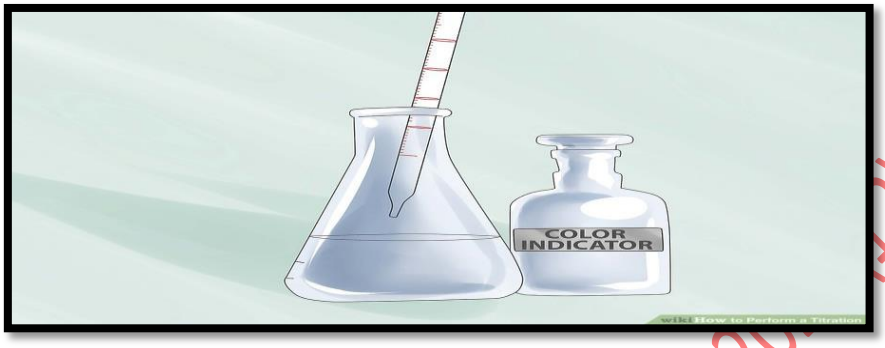
8- Put a small amount (4-5 drops) of the appropriate color indicator into the beaker.



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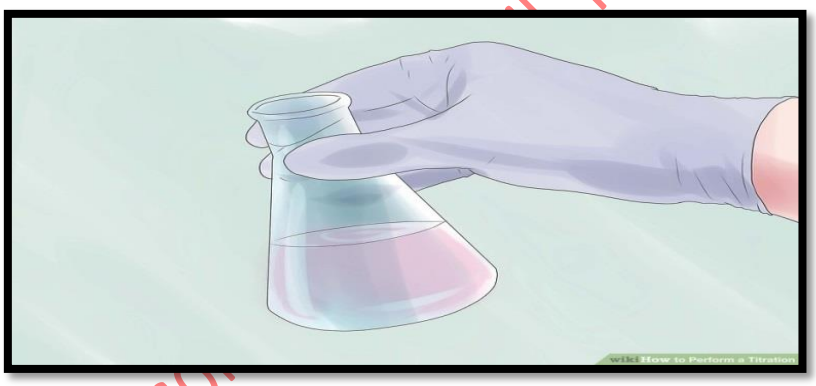
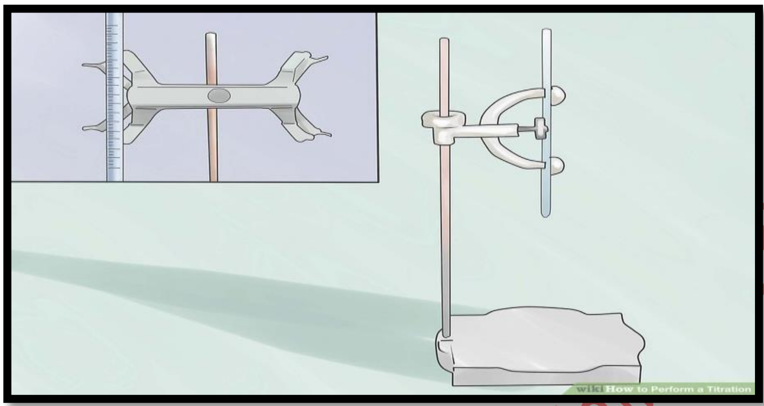
9-Agitate the beaker's contents by swirling the beaker.



10-Fill the burette with an excess amount of titrant (chemical that reacts with the analyte). The titrant should be in an aqueous form.

****

11-Clamp the burette carefully to a burette stand. The tip of the burette should not be touching any surfaces



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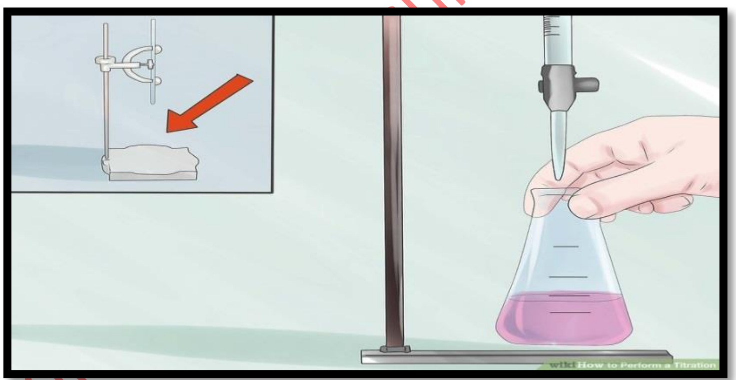
12-Place the beaker under the burette.



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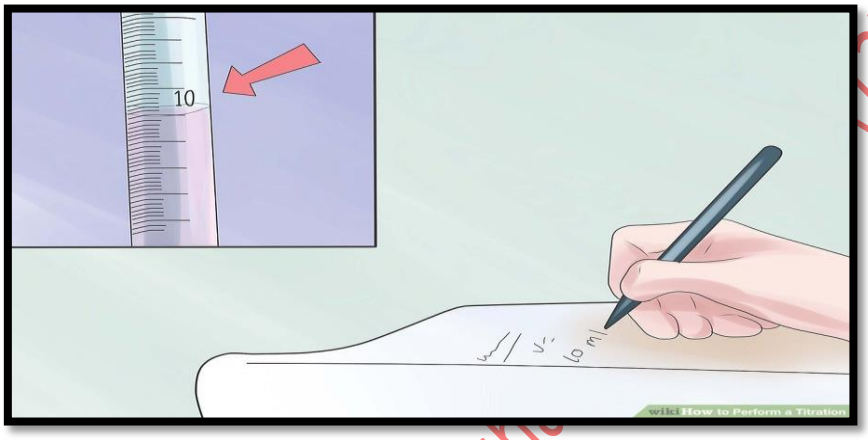
13-Hit the stood burette carefully with your index finger in order to remove bulb gases inside the liquid then record the initial volume of the burette at the meniscus (the lowest part of the dip in the liquid).



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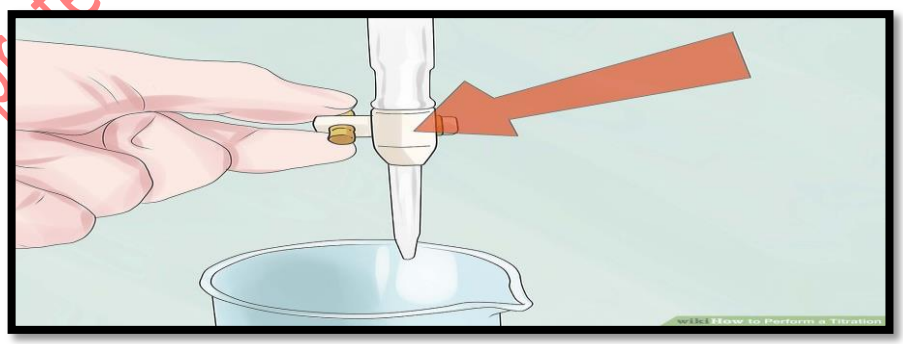
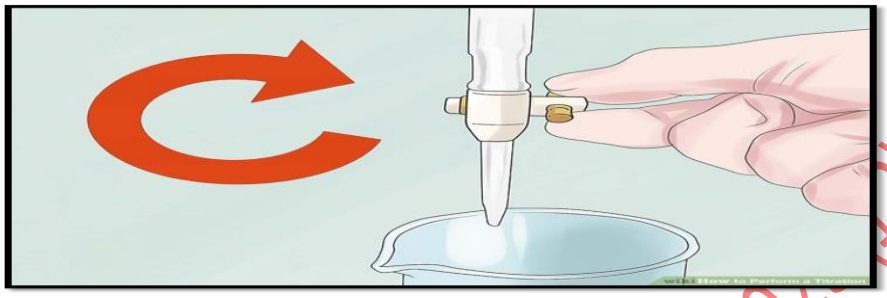
14-Turn the stopcock of the burette (valve near the tip) vertical, so that titrant is added to the beaker. Only let a small amount of the titrant out. A color change should occur. Agitate the beaker until the color disappears.



Lect.4.

15-Repeat the above step until the color persists slightly (you may (barely notice it, so be careful & go extremely slowly).



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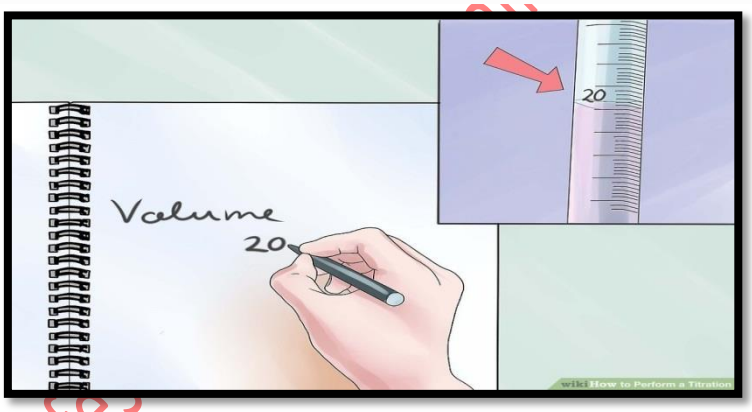
16- Record the volume of the burette.



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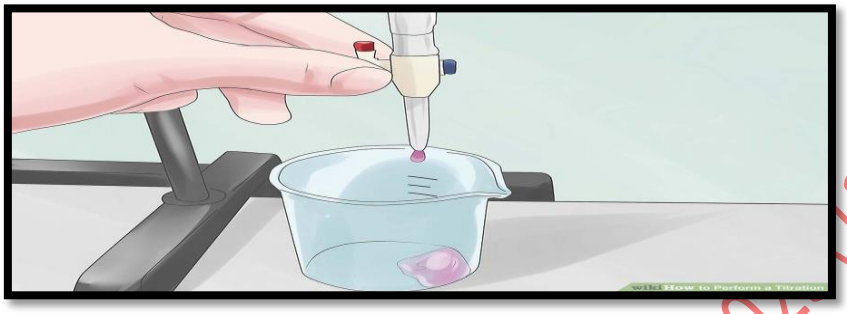
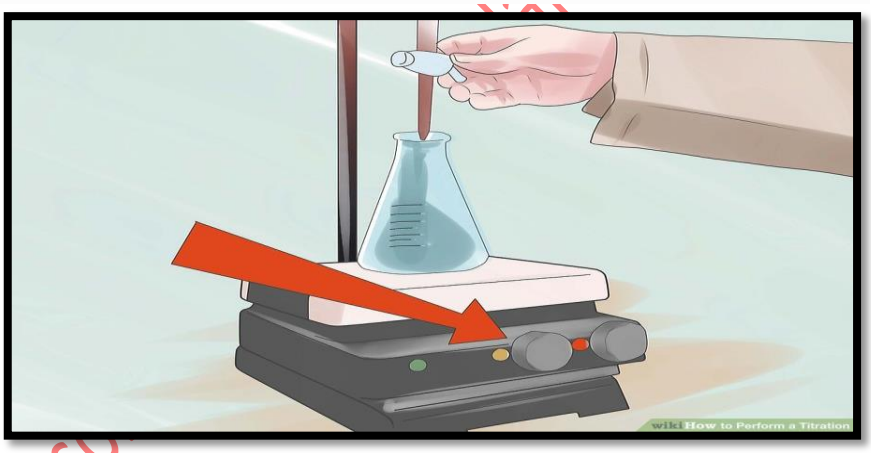
17-Add titrant drop by drop as you near the endpoint.



18-Agitate the beaker's contents after every drop.



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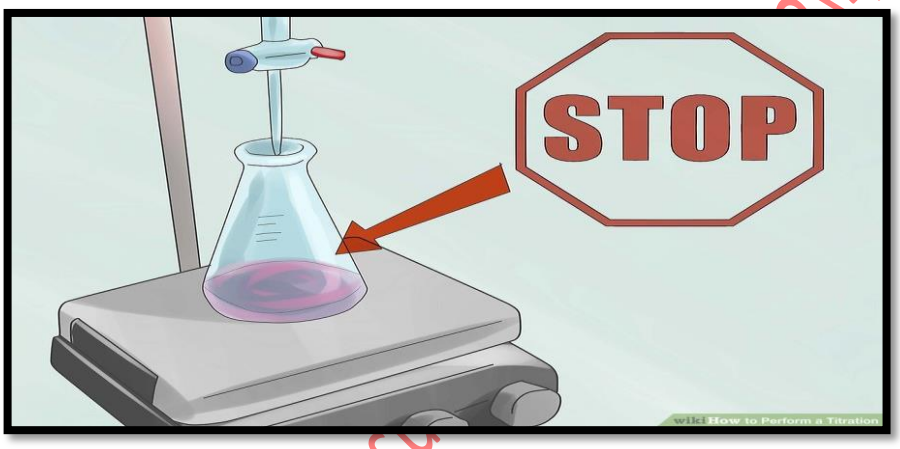
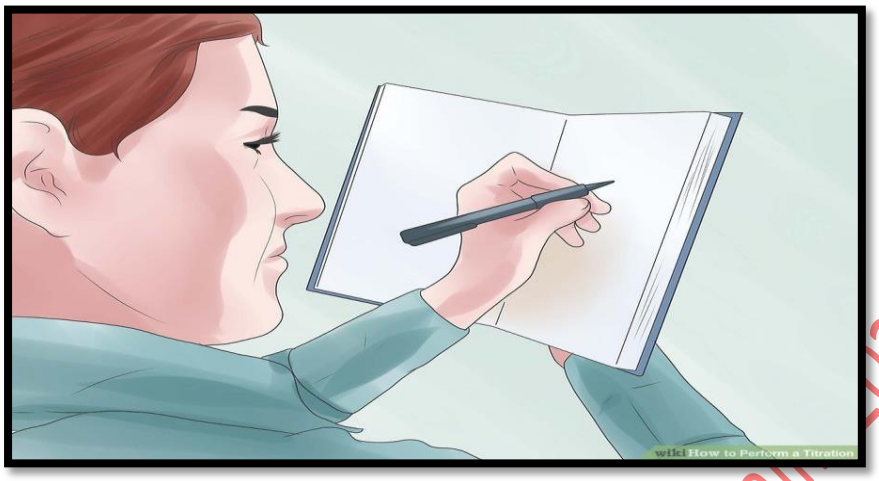
19-Stop when you've reached endpoint, which is the point when the reactant within the analyses has been completely neutralized. You can tell you've reached the endpoint with a color change, depending on which indicator you chosen to use.



20-Record your final volume.



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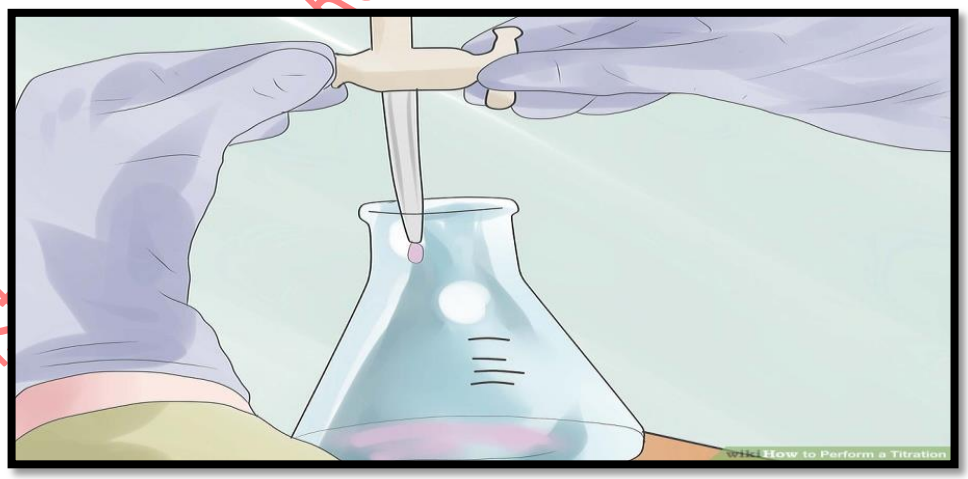
21-Add drops of titrant until you pass endpoint. At this point, the beaker's contents should be entirely the color of the color indicator when titrant is added.



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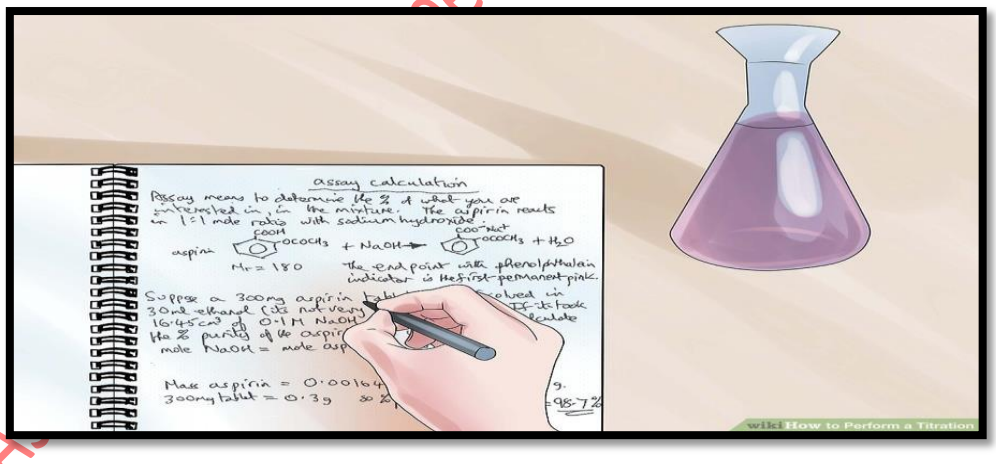
Lect.4.

22-Clean up by wiping away all standing water.

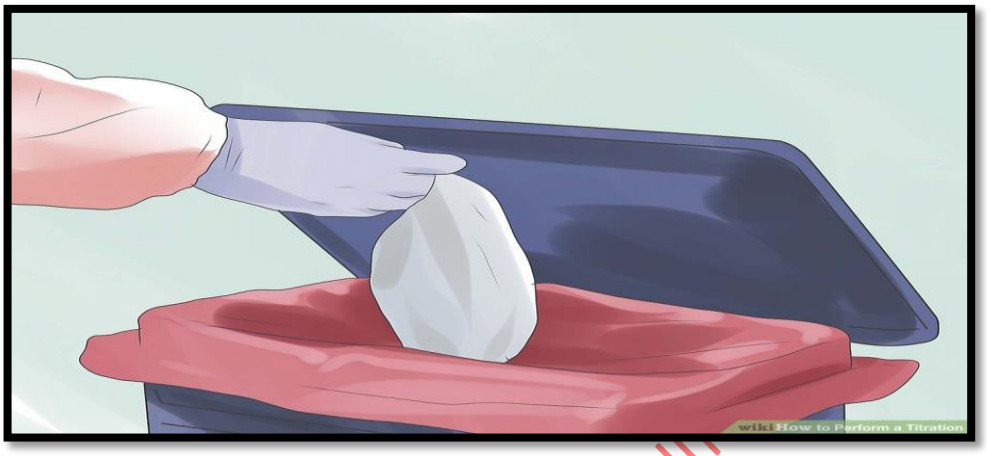
****

23-Calculate the concentration of the reactant within the analyte using the data gathered.



Lect.4.

24-Dispose of the chemicals used in a labeled waste container



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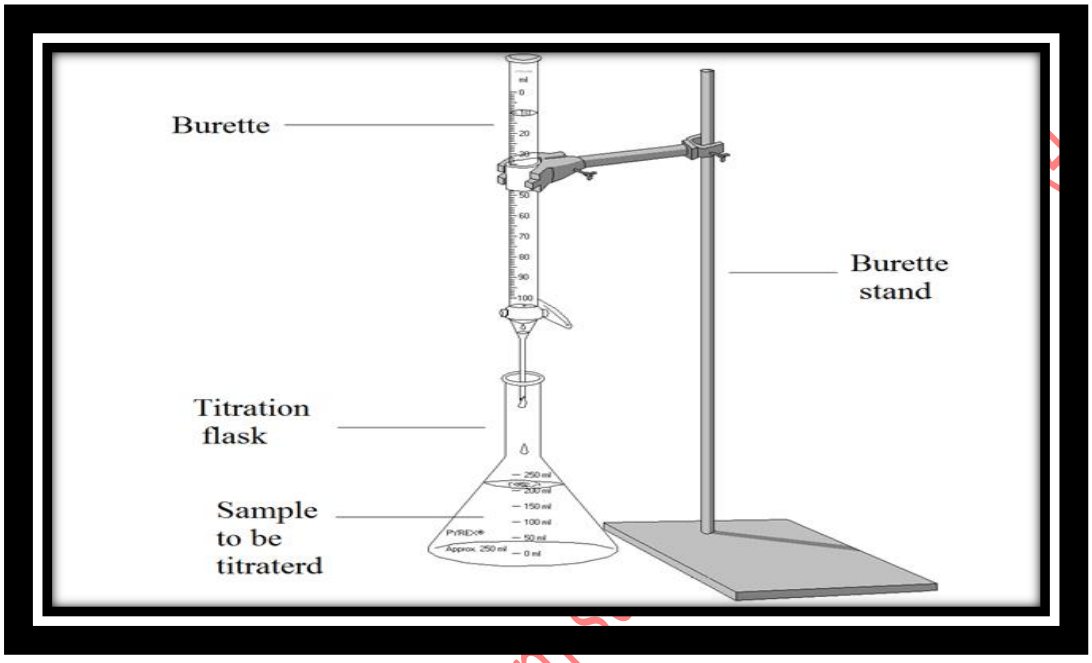
Lect.4.

How To Titration.



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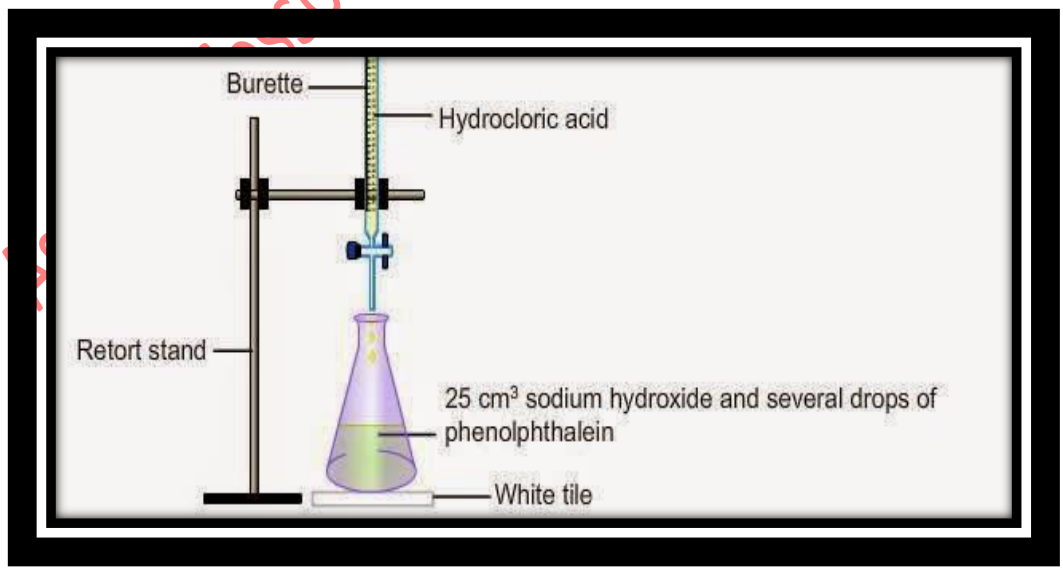
Titration Hcl with NaOH



Lect.4.

How to measure the PH of solution ?

Two ways to measure PH

indicators.*

PH meter.*

Litmus paper.*

****

(Indicators): is substance can change color depending on the PH meter of the solution or other chemical changes.)

****

PH meter

A pH meter is a scientific instrument that measures the hydrogen-ion activity in water-based solutions. indicating its acidity or alkalinity expressed as pH. The pH meter measures the difference in electrical potential between a pH electrode and a reference electrode, and so the pH meter is sometimes referred to as a "potentiometric pH meter". The difference in electrical potential relates to the acidity or pH of the solution. The pH meter is used in many applications ranging from laboratory experimentation to quality control.

****

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Lect.4.

Types of PH meters.

1- Natural indicators(Litmus paper is natural dye that can turn red color in acid to blue color in base

A simple pH meter

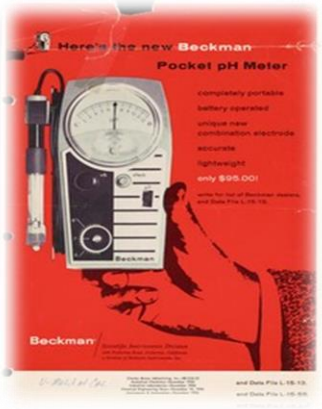
****

2-synthetic indicators(such methyl red , methyl orange).

Soil pH meter

****

Special pH meter



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Lect.4.

Special pH meter

****

Table .1 indicators and their PH Ranges:

Indicators	Acid Color	Base Color	PH Range of color change
Methyl orange	Red	Yellow	3.1-4.4
Methyl Red	Red	Yellow	4.8-6.0
Phenolphthalein	Colorless	Pink	8.2-1.00
Bromothymol Blue	Yellow	Blue	6.2-7.6

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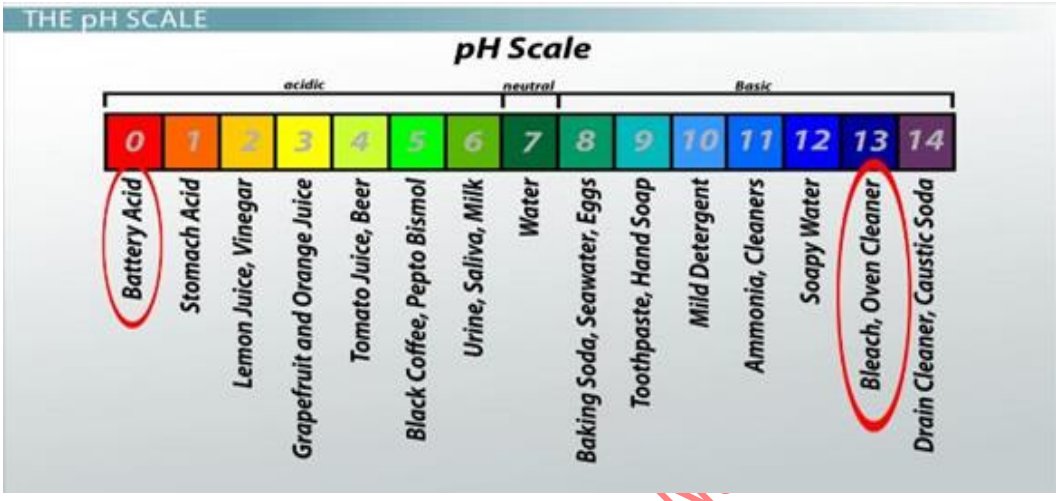
Lect.4.

PH Scale.



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pH=7

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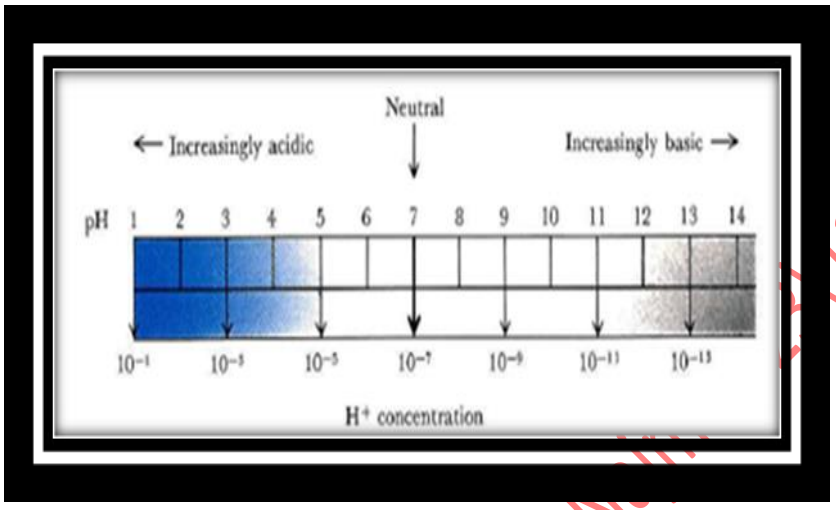
Lect.4.

PH (acid , base , Neutral).



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Titrations Calculation

1-The goal of Titrations is to determine the concentration of solution in the Titration flask or original amount of acid and base.

2. Concentration (M) =no. of moles (n)\ V liter.

3. nH+ =nOH-(when n= No . of moles).

(M1*V1)acid=(M2*V2)base

****

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Lect.4.

Example 10

A student titrates(40 ml) of an HCl solution of unknown concentration with a (0.55M) NaOH solution . the volume of base solution needed to reach the equivalence point is (24.64ml), what the concentration of HCl solution in moles per liter ?

V HCl =40 ml
V NaOH =24.64ml
C NaOH = 0.55M
C HCl=?

C HCl= (M1*V1)acid =(M2*V2) bas

$$M1=\frac{0.55M*24.64ml}{40\ ml}$$ =0.3388 mole \liter is concentration of HCl .

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Lect.4.

Date and Result (Work page)

Name----------

Date------\-----\----

No. of trial	Volume of HCl
Trial1	5
Trial2	10
Trial3	14
Trial4	20

Average of volume =∑ Volume of HCl \∑ trial

5+10+14+20=49\4=12.25
(M1*V1)acid =(M2*V2) base

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