**Week1**

**Introduction:**

**Quantitative analysis**: is the determination of the absolute or relative amount (often expressed as a concentration) of one, several or all substance(s) present in a sample.

Quantitative Classical Chemical Analysis

Titrations

Acid-base

Precipitaiton

Complexometric

Redox

Titrations involving iodine (I2)

Iodimetry

Iodometry

Iodometric titration of copper

Gravimetry

Dichromatometric

KMnO4

Permanganimetric

**Titration**: is the process, operation, or method of determining the

concentration of a substance (analyte) in solution by adding to it a standard reagent (titrant) of known concentration in carefully measured amounts until a reaction of definite and known proportion is completed, as shown by a color change or by electrical measurement, and then calculating the unknown concentration.

**Equivalence point**:

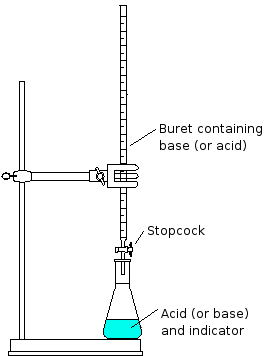
The point in a titration where the amounts of titrant and material being titrated are equivalent chemically.

**The end point :**

The [physical change](http://www.everythingbio.com/glos/definition.php?ID=2123) which results when the [equivalence point](http://www.everythingbio.com/glos/definition.php?ID=1025) has been reached.

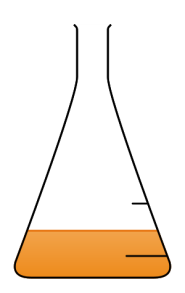
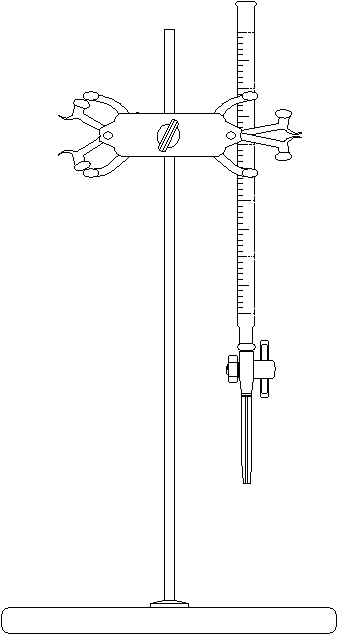
In colorimetric [titration](http://www.everythingbio.com/glos/definition.php?ID=2701)s, this is a color change of the [indicator](http://www.everythingbio.com/glos/definition.php?ID=4168)

**Titration set up:**

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**The apparatus**

Conical flask Burette

Funnel Pipette

[](http://images.google.com/imgres?imgurl=http://www.thesciencefair.com/Merchant2/graphics/00000001/VolPiptSt6_M.jpg&imgrefurl=http://www.thesciencefair.com/Merchant2/merchant.mvc?Screen=PROD&Product_Code=3871-55&Category_Code=PIP&usg=__qud53-QMIdUGjEr6agxcUzXrnvk=&h=400&w=332&sz=26&hl=en&start=1&um=1&itbs=1&tbnid=73UCLeTlAsoKdM:&tbnh=124&tbnw=103&prev=/images?q=pipet&um=1&hl=en&safe=active&sa=G&tbs=isch:1)

**Types of titration that will be encountered in 250 chem lab. :**

1- Neutralization titration (Acid –base reaction)

2- Precipitation titration.

3- Complexometric titration.

4- Redox titration.

**Acid –base reactions**

These titrations are based on the neutralization reaction that occurs between an acid and a base, when mixed in solution.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Acid** | **+** | **Base** | http://www.saskschools.ca/curr_content/chem30/images/darrow.gif | **a Salt** | **+** | water |
|  |  |  |  |  |  |  |

## **Key Concepts:**

* Acid-base reactions involve a proton transfer
* The acid donates a proton to the base
* Acid-base reactions are also known as neutralization reactions
* Equivalence point is the point at which the moles of H+ is equal to the moles of OH-
* An [indicator](http://www.ausetute.com.au/indicata.html) is used to show the equivalence point during a titration

**Acid-base Titration curves:**

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|  |  |  |  |
| --- | --- | --- | --- |
| **General Type** | **Example** | **Typical Titration Curve** | **Features of Curve** |
| Strong Acid and Strong Base | HCl added to NaOH | http://www.ausetute.com.au/../images/titphsab.gif | Curve begins at high pH typical of strong base and ends at low pH typical of strong acid.  There is a large rapid change in pH near the equivalence point (pH =7). |
| Strong Base and strong Acid | NaOH added to HCl | http://www.ausetute.com.au/../images/titphsba.gif | Curve begins at low pH typical of strong acid, and ends at high pH typical of strong base.  There is a large rapid change in pH near the equivalence point (pH=7). |
| Weak Acid and Strong Base | NaOH added to acetic acid (CH3COOH) | http://www.ausetute.com.au/../images/titpsbwa.gif | Curve begins at a higher acidic pH and ends at high basic pH.  The pH change at the equivalence point (pH > 7)is not so great. |
| Strong Acid and Weak Base | Ammonia (NH3) added to HCl | http://www.ausetute.com.au/../images/titpwbsa.gif | Curve begins at low pH and ends at a less high basic pH.  The pH change at the equivalence point (pH < 7) is similar to that for Strong Base and Weak Acid. |
| Weak Acid and Weak Base | Ammonia (NH3) added to Acetic acid (CH3COOH) | http://www.ausetute.com.au/../images/titphwab.gif | Curve begins at higher acidic pH and ends at low basic pH.  There is not a great pH change at the equivalence point (pH ~ 7) making this a very difficult titration to perform. |

**Volumetric analysis to prepare and standardize Hydrochloric Acid**

\*prepare 0.1 M HCl.

\*The reaction between sodium carbonate and hydrochloric acid takes place in two stages:

**Na2CO3 (aq) + HCl (aq) → NaHCO3 (aq) + NaCl (aq) (1)**

**NaHCO3 (aq) + HCl (aq) → NaCl (aq) + CO2 (g) + H2O (l) (2**)

Two indicators are needed to cover both stages:

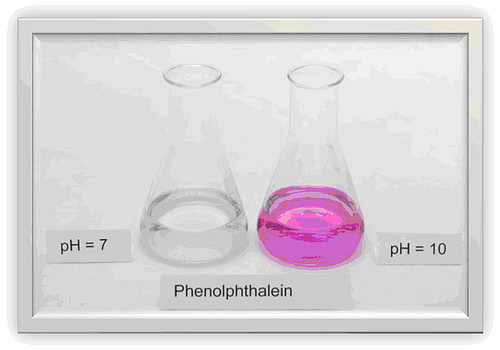
• In stage 1, phenolphthalein is most suitable, and will respond to the pH change associated with the formation of sodium hydrogen carbonate, NaHCO3.

• In stage 2, methyl orange is most suitable, and will respond to the pH change associated with the final formation of sodium chloride, NaCl.

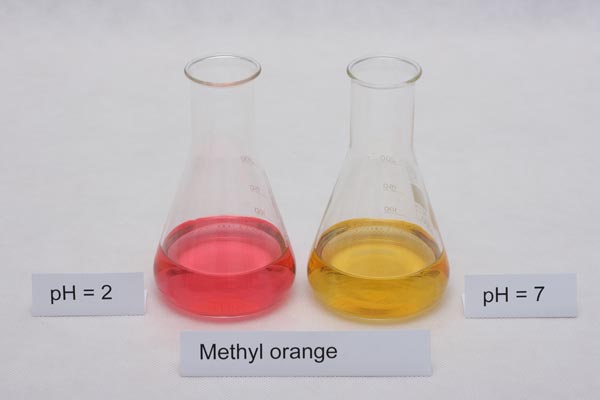
**Procrdure:**

1. Transfer a 10 ml aliquot (portion) of sodium carbonate solution to a 250 cm3 capacity conical flask. Add a few drops of phenolphthalein indicator solution.

2. Titrate with the hydrochloric acid. The end-point of the titration is when the solution just changes from pink to colorless. Equation (1)



3-repate the process by methyl orange indicator solution, the end-point of the titration is when the solution just changes from yellow to orange equation (2)



4- Repeat steps 1 - 3 until concordance (i.e. until the readings are the same or within 0.2cm3).

5-Tabulate your titration results.

Results:

|  |  |
| --- | --- |
| Burette reagent |  |
| Conical flask reagent |  |
| Indicator |  |

|  |  |  |  |
| --- | --- | --- | --- |
| Mean volumes | Volume 3 | Volume 2 | Volume 1 |
|  |  |  |  |

6- Do the calculations using the following equation:

V1 M1 = V2 M2

Where:

V1 = volume of titrant used for the known solution  
V2 = volume of titrant used for the unknown solution  
M1 = Molarity of the known solution  
M2 =Molarity of the unknown solution

# Titration of Sodium Hydroxide with Hydrochloric Acid.

**The reaction:**

HCl + NaOH NaCl +H2O

**procedure :**

1. Pipette 10 ml of Sodium hydroxide solution into 250 ml conical flask.
2. Add 1-2 drops of Phenolphthalein solution.
3. Titrate with hydrochloric acid solution till the first color change.
4. Calculate the concentration of Sodium Hydroxide .