Leaving Cert Chemistry

Free Notes

Volumetric Analysis

Volumetric Analysis - Titration Procedures

Ordinary Level will **ONLY** need to know the following titrations in depth:

1) HCl (Hydrochloric Acid) & NaOH (Sodium Hydroxide) (Strong acid/strong base)
2) HCl (Hydrochloric Acid) & Na_2CO_3(Sodium Carbonate) (Strong acid/weak base)

Definitions to remember:

- **Standard Solution** is one whose concentration (strength) is known **accurately** e.g. standard solution of sodium carbonate
- **Primary Standard** is one that can be made up **directly** using a measured amount of **pure** solid.
- In order to be a good primary standard, a substance must be: a) of high purity, b) stable, c) no waters of hydration (not hydroscopic or hygroscopic), d) have a high molar mass and e) be soluble in the solvent of interest
- Can't use following as **Primary Standards**
  - MnO_4^- as because *it can't be got pure (very reactive).*
  - Iodine [I_2] because *it sublimes*.
  - KOH or NaOH they absorb CO_2 and moisture
- **Secondary Standard** Make up a solution and then standardise this solution using a primary standard.
- **Standardise** means to find the concentration of a solution using titration

Titration Procedures: The following titration apparatus MUST be learned!!!

1) **Pipette:**

- Rinse with deionised water – this is performed ***to wash out any impurities*** **from previous use**
- Then it is to be washed with the solution it is going to contain - ***to wash out any of the remaining deionised water***.
- Fill the pipette with the substance using pipette filler – *be careful when handling as the* ***solution may be poisonous or caustic***.
- Always Read from the bottom of the meniscus
  - This level normally has a brown ring on the stem
  - You should be Eye level with this.
- Empty the contents into a clean conical flask and touch tip against the side or surface.
- NEVER BLOW THIS LAST DROP. The pipette is calibrated to allow for the drop at the tip.

2) Burette

	• Firstly, Rinse with deionised water (to clean it) • Then with the solution it will contain. • Fill using a funnel and remove it as drops may fall from it or it may dip into the liquid giving a false level. • Remove the air bubble from the tip by gently opening the tap of burette (in diagram shown) quickly • Read from the bottom of meniscus - with eye level with this point – **FOR CLEAR SOLUTIONS** • **HIGHER LEVEL**: **$KMnO_4$** - read from the top of the meniscus *(or from the bottom with a light behind)* • Don't put NaOH in burette as it often reacts with glass of burette and blocks tap by the formation of a white solid

3) Conical Flask:

	• Rinse out with deionised water **only**. If you rinse with solution it will affect the moles of reagent during the titration. • Place on white tile – ***this is used to help us observe colour changes during the titration and the end point.*** • Mix the contents constantly. • Add **only** a few drops of indicator *(the indicator itself is a weak acid or base and could disturb the results)* • Wash down drops on the side of the flask with deionised water. *(This won't affect amount of reactant in the flask or change the titre results.)*

4) Volumetric Flask:

	• Volumetric flasks have a long thin neck to make it accurate for measurement. • A solution is made up to 1cm from the graduation mark with deionised water, then using a dropper more deionised water is added until the bottom of the meniscus sits on the graduation mark • Read from the bottom of the meniscus at eye level. • Get bottom of meniscus level with calibration mark. • Mix by inverting 20 times to ensure solution is homogeneous (evenly mixed – the long thin neck makes this possible).

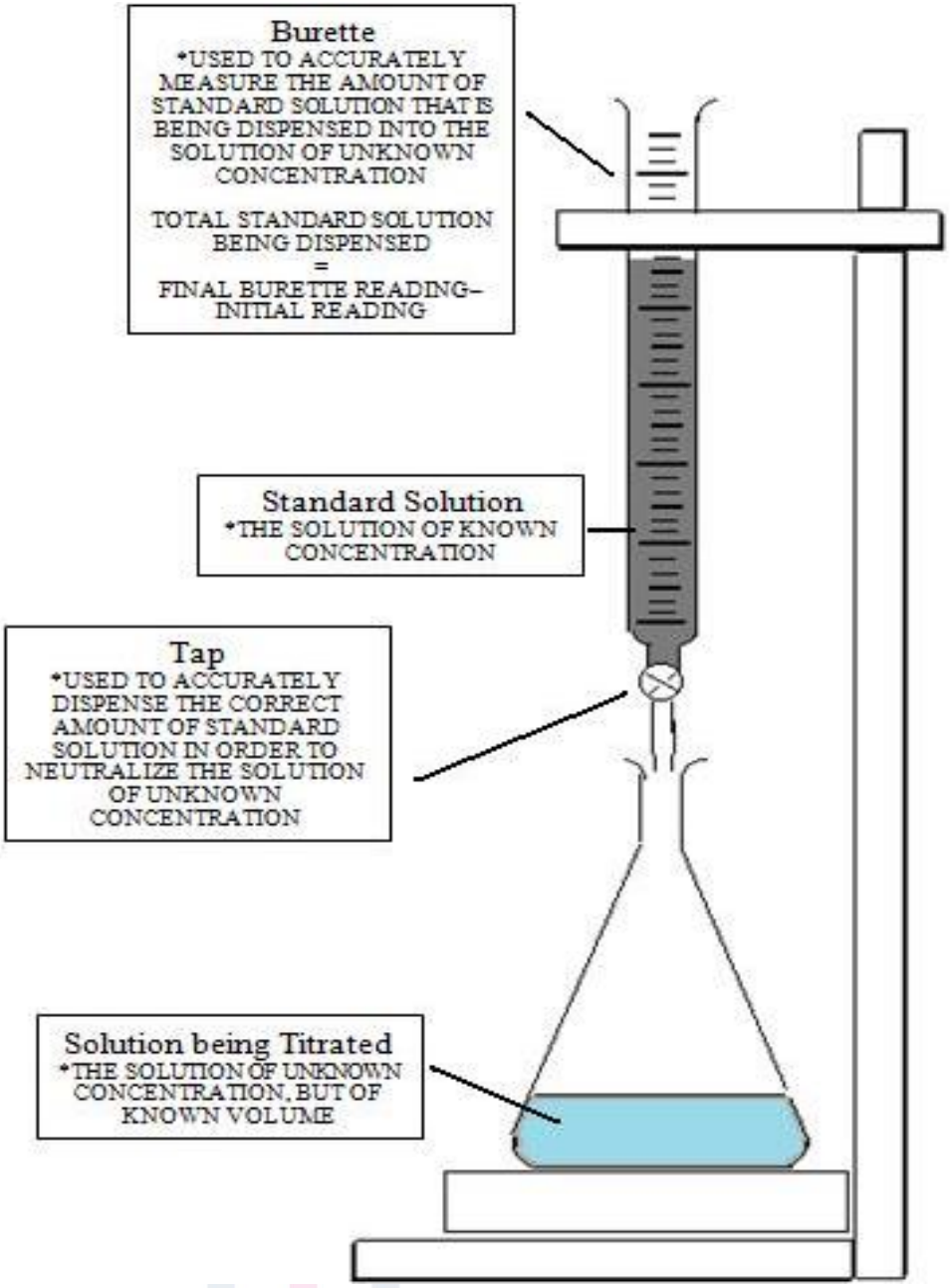
The Titration Process: Points to remember

- One rough titration and two accurate titres are performed.
- The rough titration is only used for indication purposes and figures obtained during the titration should be disregarded
- Two accurate should be within 0.1 cm^3 of each other
- After the two figures are obtained and recorded you average the two accurate titre figures
- Remember to mix conical flask contents well by swirling
- The solution from the burette is allowed to flow into the conical flask drop by drop near the **end point.**
- The **End Point** is the point at which the reaction is complete - *shown by an obvious colour change*

Indicators that could be chosen:

Indicator used and which titration	**Colour in Acid**	**Colour in Alkali**
Phenolphthalein (Ethanoic acid & Sodium Hydroxide)	Colourless	Pink
Methyl orange (Hydrochloric acid + Sodium Carbonate)	Red / pink	Yellow
Litmus	Red	Blue

Starch (Redox titrations involving bleach, sodium Thiosulfate and waters; dissolved oxygen content)	**Blue when iodine [I_2] present**	**Colourless when iodine absent**
MnO_4^{1-} (Iron tablet & ammonium sulphate)	Pink when present	Colourless when absent [all turned to Mn^{2+}]
Eriochrome Black T (Water Hardness)	Wine red when Ca^{2+} present	Blue when Ca^{2+} gone



Indicator Choice:

- **S**trong **A**cid **S**trong **B**ase - **A**ny indicator e.g. HCl + NaOH
- **S**trong **A**cid **W**eak **B**ase - **M**ethyl **O**range e.g. HCl + Na_2CO_3
- **W**eak **A**cid **S**trong **B**ase – **P**henolphthalein e.g. CH_3COOH + NaOH
- **W**eak **A**cid **W**eak **B**ase – **None**

3 types of titrations ONLY AT HIGHER LEVEL: 9 in total

1) Acid/Base
2) Redox Reactions: Sodium Thiosulfate, Bleach etc.

3) Water titrations

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