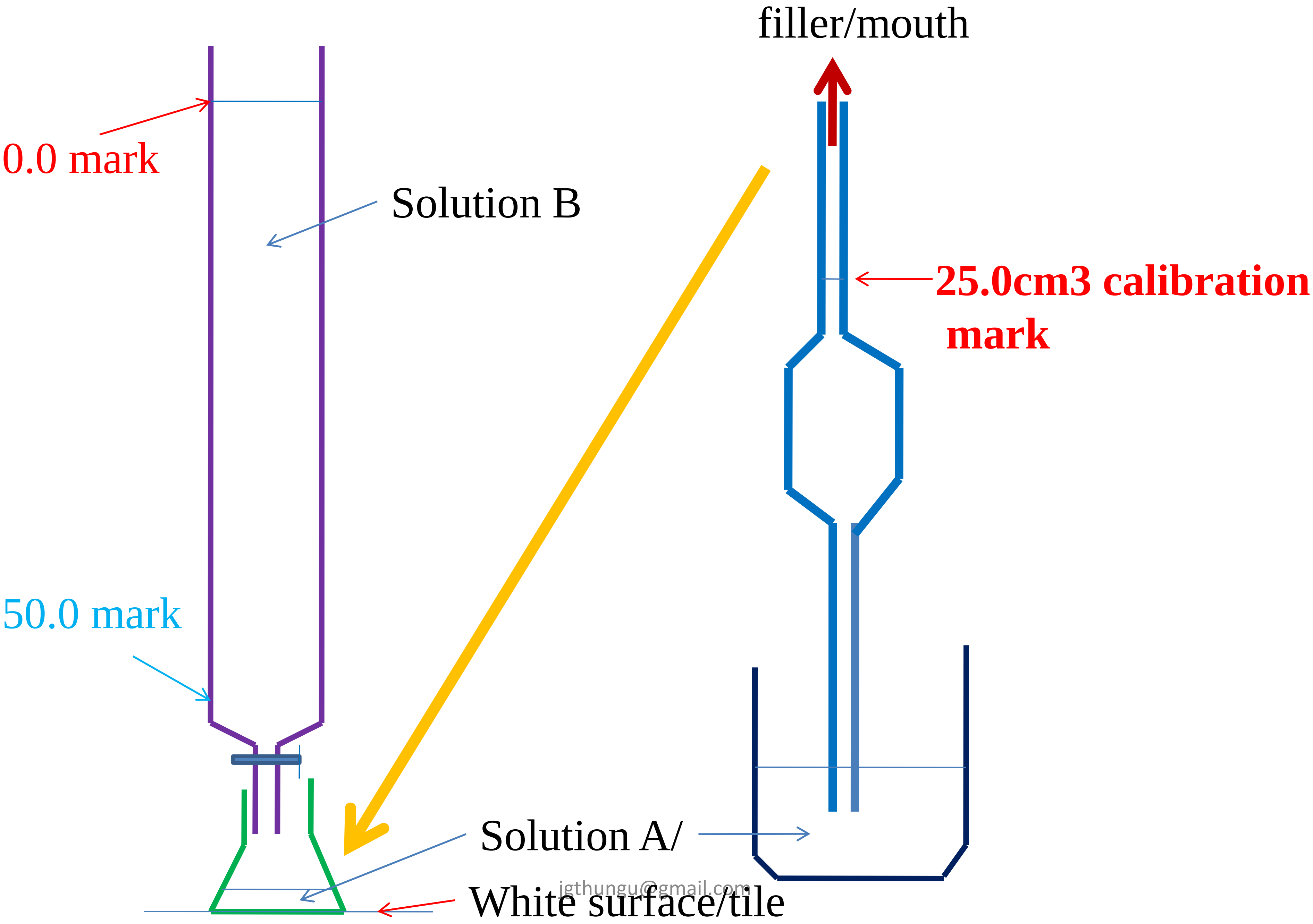
Practically volumetric analysis involves **titration**.
Titration generally involves filling a burette with known /unknown concentration of a solution then adding the solution to unknown/known concentration of another solution in a conical flask until there is complete reaction.
If solutions used are both colourless, an indicator is added to the conical flask.
When the reaction is over, a slight excess of burette contents change the colour of the indicator.This is called the end point.
The titration process involve involves determination of **titre.** The titre is the volume of burette contents/reading before and after the end point.
Burette contents/reading **before** titration is usually called the **Initial** burette reading.
Burette contents/reading **after** titration is usually called **Final** burette reading.
The titre value is thus a sum of the **Final** less **Initial** burette readings.
To reduce errors, titration process should be repeated at least **once more**.
The results of titration are recorded in a **titration table**

Set up of Titration apparatus



Sample titration table

Titration number	1	2	3
Final burette reading (cm3)	20.0	20.0	20.0
Initial burette reading (cm3)	0.0	0.0	0.0
Volume of solution used(cm3)	20.0	20.0	20.0

As **evidence** of a titration **actually** done,examining body requires the candidate to record their burette readings **before** and **after** the titration.

For KCSE candidates in Kenya burette readings **must** be recorded in a titration table in the **format** **provided** by the Kenya National Examination Council.

As **evidence** of all titration **actually** done, candidates should record their burette readings before and after the titration to **complete** the titration table **in the format** **provided**.

Calculate the average volume of solution used

$$\frac{24.0 + 24.0 + 24.0}{3} = \mathbf{24.0\ cm3}$$

As evidence of understanding the degree of accuracy of burettes , all readings must be recorded to **a decimal point**.

As evidence of **accuracy** in carrying the out the titration , candidates value should be **within 0.2** of the **school value** .

The school value is the **teachers** readings presented to the examining body/council based on the concentrations of the solutions s/he presented to her/his candidates.

Bonus mark is awarded for averaged reading **within 0.1** school value as **Final accuracy**.

Calculations involved after the titration require candidates **thorough practice mastery** on the:

(i)relationship among the mole, molar mass, mole ratios, concentration, molarity.

(ii) mathematical application of 1^{st} principles.

Very useful information which candidates forget appears usually in the beginning of the paper as:

"**You are provided with...**"

All calculation must be to the **4^{th} decimal point** unless they divide fully to a lesser decimal point.

Candidates are expected to use a non programmable scientific **calculators**

Sample Titration Practice 1(Simple Titration)

You are provided with:

0.1M sodium hydroxide solution A

Hydrochloric acid solution B

You are required to determine the concentration of solution B in moles per litre.

Procedure

Fill the burette with solution B.

Pipette 25.0cm3 of solution A into a conical flask.

Titrate solution A with solution B using phenolphthalein indicator to complete the titration table 1

Sample results

Titration number	1	2	3
Final burette reading (cm3)	20.0	20.0	20.0
Initial burette reading (cm3)	0.0	0.0	0.0
Volume of solution B used(cm3)	**20.0**	**20.0**	**20.0**

Sample worked questions

Calculate the average volume of solution B used

Average titre = $\frac{\text{Titre 1+Titre 2+Titre 3}}{3}$ => $\left(\frac{20.0 + 20.0 + 20.0}{3}\right)$ = **20.0cm3**

2. How many moles of:

(i)solution A were present in 25cm3 solution.

Moles of solution A = $\frac{\text{Molarity x volume}}{1000}$

=> $\frac{0.1 \times 25}{1000}$ = **2.5×10^{-3}** moles

(ii)solution B were present in the average volume.

Chemical equation: NaOH(aq) + HCl(aq) -> NaCl(aq) + H_2O(l)

Mole ratio 1:1 => Moles of A = Moles of B = **2.5×10^{-3}** moles

(iii) solution B in moles per litre.

Moles of B per litre = $\frac{\text{moles x 1000}}{\text{Volume}}$ = $\frac{2.5 \times 10^{-3} \times 1000}{20}$ = **0.1M**