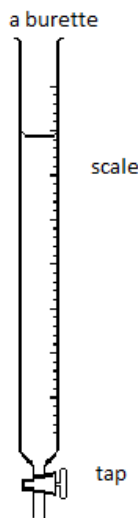




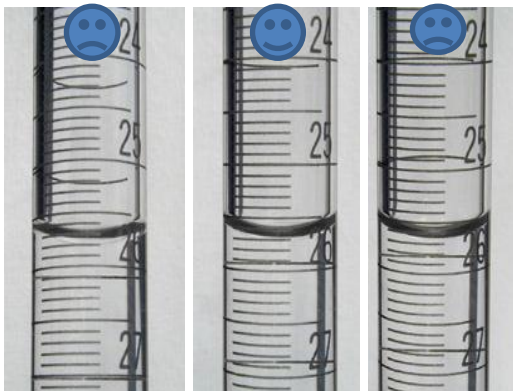
**Burette** – use to accurately measure the volume of liquid needed in a reaction



Rinse the burette with some of the *solution that you are going to use in your titration*. Don't use water!

Don't forget to check that there are **no air gaps below the tap** – drain some of the liquid through until all air has gone!

**Burette Scales** – read to the bottom of the meniscus – you can read to 0.05 mL (half way between the 0.1 mL divisions). Eye is level with the bottom of the curve. Some say you can read to 0.02 mL with care and practice!



Eye is too low in the first picture and too high on the third. The middle gives **correct reading** of 25.65 (mL)

**Example results table** – the volume delivered is the difference between the last scale reading and the first (initial) scale reading. Answers must not be negative!

Example

	Rough	1st	2nd	3rd
Final volume ( mL)	15.30	30.10		
Initial Volume ( mL)	0.00	15.30		
Volume used (mL)	15.30			

Record volumes to 2 decimal places. Your initial reading does not have to start at 0.00 mL

You are aiming for **3 results within 0.2 mL of each other**. It should be possible to get them **within 0.10 mL**. These will then be classed as concordant results. **You use concordant results to calculate the average titre.**

**Pipette** – used to accurately measure a volume of solution and deliver into a conical flask.

- Volumes measured are usually 20.0 or 25.0 mL. At our school we use Diji pipettes.

Make sure you are familiar with the type of pipette that you will use in your assessment.

*You rinse a pipette before use with a little of the solution you will be using it with.*

**Diji example** – deliver a 20.0 mL sample into a conical flask



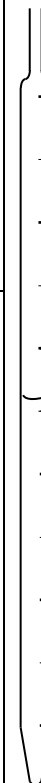
**Pipette Techniques – may vary according to the type of pipette you use at your school**

Keep pipette vertical

Use a slow smooth action

Eye level with the bottom of the meniscus.

Touch tip of pipette on side of conical flask at end of delivery.





### Selecting your data

You are looking for **3 concordant results** – ie values that differ from each other by **0.10 mL** – if not then choose the 3 closest values

expt	rough	1	2	3	4
Final	14.00	27.20	40.60	13.60	26.90
Initial	0.20	14.00	27.20	0.00	13.60
Volume added (mL)		<b>13.80</b>	<b>13.20</b>	<b>13.40</b>	<b>13.30</b>

In this case a good choice would be to select the following data values

**13.20 mL 13.30 mL and 13.40 mL**

This would give an **average titre of 13.30mL** to use in our calculation

In this example it is advisable to do another titration – can you see why?

expt	rough	1	2	3	4
Final	15.70	30.60	46.20	15.30	30.60
Initial	0.00	15.70	30.60	0.20	15.30
Volume added (mL)					

**Titre values will be 15.70 ; 14.90; 15.60; 15.10 and 15.30 mL - still need 3 within 0.10 mL**

### Example calculation

Remember that  $c = n/V$   
 $c$  = concentration in mol L<sup>-1</sup>  
 $n$  = amount of a substance in mol  
 $V$  = volume of solution used in Litres ( L)  
 Rearrange to give  $n=cV$  when required.

#### Steps involved

- 1) Identify the **known** and the **unknown** in the problem.
- 2) Find the **amount (n)** of the **known** using the equation  **$n=cV$**
- 3) Look at the balanced equation (always supplied) to find the **amount (n)** of the **unknown** reacting
- 4) From **amount (n)** and **volume (V)** of the unknown solution use  **$c=n/V$**  to find the **concentration of the unknown in mol L<sup>-1</sup>**

To convert mL to L divide by 1000 or multiply by 10<sup>-3</sup> eg 18.0 mL = 18.0 x 10<sup>-3</sup> L  
 Don't forget to do this!

Eg 20.0 mL of unknown concentration of NaOH(aq) was reacted with 10.0mL of a solution of 0.150 mol L<sup>-1</sup> HCl (aq)



- 1) **Known** = HCl and **unknown** = NaOH
- 2)  $n(\text{HCl}) = cV = 0.150 \text{ mol L}^{-1} \times 10 \times 10^{-3} \text{ L} = 1.5 \times 10^{-3} \text{ mol}$  of HCl reacted
- 3) ratio HCl : NaOH = 1:1 so  $n(\text{NaOH})$  is also  $1.5 \times 10^{-3} \text{ mol}$  reacted
- 4)  $c(\text{NaOH}) = n/V = 1.5 \times 10^{-3} \text{ mol} / 20 \times 10^{-3} \text{ L}$   
**answer = 0.0750 mol L<sup>-1</sup> (3 s.f.)**

**ACHIEVEMENT:** Carry out quantitative analysis involves:

- collecting titration data that contains at least three titre values that fall within a range of 0.4 mL; the average titre value must be within 0.8 mL of the expected outcome
- solving quantitative problems that use the relationships  $n=m/M$  and  $c=n/V$  to calculate one variable given the other two (the relationships are not given). Molar masses for substances may be provided. Calculations must be carried out using appropriate procedures (not provided).

**MERIT:** Carry out in-depth quantitative analysis involves:

- collecting titration data that contains at least three titre values that fall within a range of 0.4 mL; the average titre value must be within 0.5 mL of the expected outcome
- solving quantitative problems that involve at least two steps and require application of relationships such as  $n=m/M$  and  $c=n/V$ . Titration calculations must be carried out correctly using only concordant titre values.

**EXCELLENCE:** Carry out comprehensive quantitative analysis involves:

- collecting titration data that contains at least three titre values that fall within a range of 0.2 mL; the average titre value must be within 0.2 mL of the expected outcome
- solving quantitative problems that involve more than two steps, and the use of stoichiometric principles. Answers to calculations must demonstrate correct units and appropriate use of significant figures.