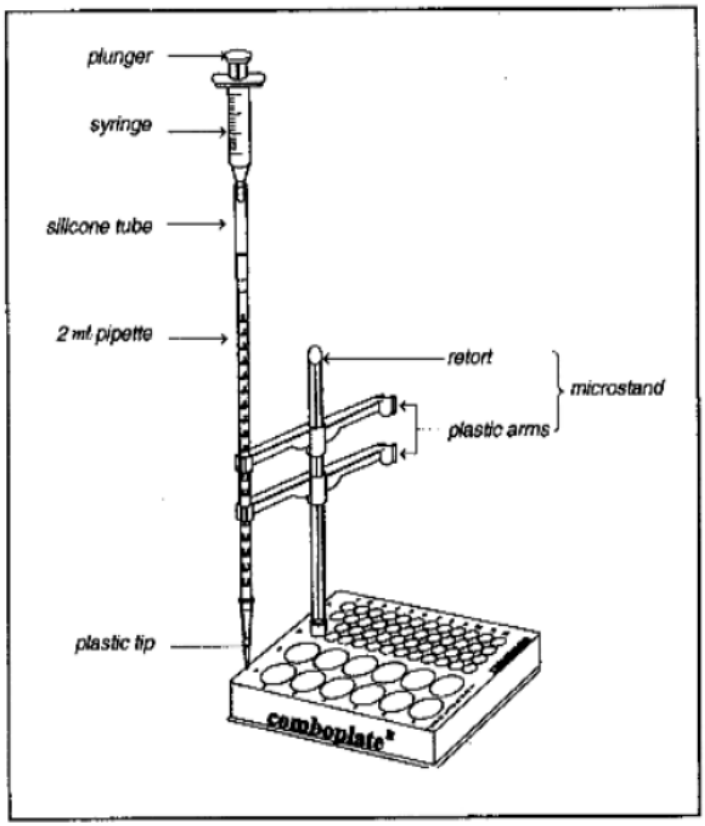
Experiment to determine the concentration of a solution of hydrochloric acid

Each student will require the following apparatus and chemicals: —
Comboplate
Microtitration kit
Propette
Microspatula
White laminated sheet
Standard 0.100 mol dm^{-3} sodium carbonate solution
Approximately 0.120 mol dm^{-3} hydrochloric acid
Methyl orange indicator

The microburette apparatus used is shown below:
The base of the microstand should be positioned in well D2 and the two plastic arms placed in the way shown.



Procedure

1) Rinse out your microburette with the hydrochloric acid solution.

a) Fill it up to the zero mark with the solution of hydrochloric acid. Make sure there are **no air bubbles** in the disposable tip.
b) Place the microburette in the microburette stand as shown in the diagram opposite.
c) Ensure that the disposable tip is not directly over the wells to be used.

2) Rinse out the 2 cm^3 pipette with the **standard** sodium carbonate solution.
3) Add **1 cm^3** of sodium carbonate separately to wells F1, F2 and F3.
4) Add **1 drop** of methyl orange to each well.
5) Move the end of the microburette so that it is positioned over well F1.
6) a) Titrate the hydrochloric acid against the sodium carbonate solution by adding **a drop at a time**.
b) After each addition **stir the mixture** with a microspatula.
c) Continue adding the acid to the sodium carbonate until the **yellow** colour just changes to **orange**. If it goes red then you have gone past the end-point.
d) Read the volume of solution from the microburette and record it in your results table on the other sheet.
e) If necessary refill your microburette.
7. Repeat the titration with the sodium carbonate in wells F2 and F3 and keep on repeating until you get results which are within 0.010 cm^3 of each other*.

*** NOTE as you get more skilled in your titration techniques try to get this figure down to 0.005 cm^3**

Results

Volume of acid added	Titration 1	Titration 2	Titration 3
Final volume			

Starting volume			
Volume added			

Use the average of the two volumes added which are within 0.01 cm^3 of each other.

Volume of acid added = _____cm^3

REMEMBER the volume of the solutions must be quoted in dm^3 and therefore your volumes have to be divided by 1000. 1 cm^3 = 1/1000 dm^3 = 1 x 10^{-3} dm^3

volume of acid added = _____dm^3

The concentration of the sodium carbonate = 0.05 $mol.dm^{-3}$

Conclusions

The sodium carbonate solution is a **standard solution**. Explain what is meant by the term '**standard solution**'.

_____

_____

The equation for the reaction is: -

$Na_2CO_3(aq) + 2HCl(aq) \quad 2NaCl(aq) + CO_2(g) + H_2O(l)$

The equation shows that ____mol. of HCl react with 1 mol. of sodium carbonate.

The number of moles of sodium carbonate ($n_{\text{sodium carbonate}}$)

$= V_{\text{sodium carbonate}} \times C_{\text{sodium carbonate}}$

$= 0.1 \times 10^{-3} \times 0.05$

$= 5.00 \times 10^{-5}$ mol.

n_{HCl} = ____ x 5.00×10^{-5} mol.

Concentration of HCl = n_{HCl} / V_{HCl}

=

The concentration of the hydrochloric acid

= _____ $mol.dm^{-3}$