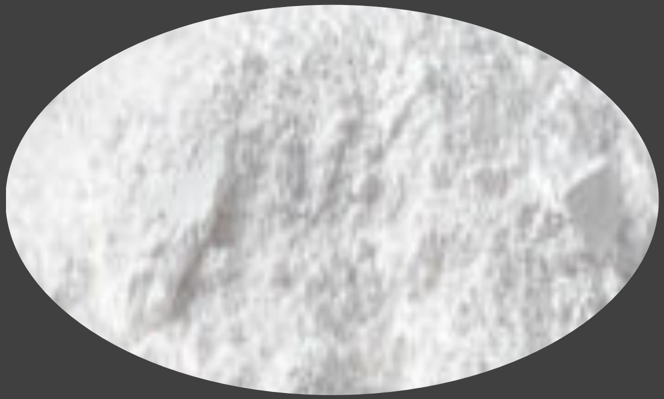
Back Titrations – Introduction and Worked Example

What is the point of back titrations?

Back titrations allow us to find the purity of solids and when the reaction is too slow to use a standard titration technique.



How could I find the purity of this sample of calcium carbonate contaminated with calcium sulphate?

We add drop by drop 1 mol/dm^3 $HCl_{(aq)}$ until we no longer observe bubbles been produced?

How accurate would this method be?

Worked Example – Finding %purity

Step 1
5.00 g of the impure calcium carbonate is placed in a beaker. 50.00 cm^3 of 1.00 mol/dm^3 $HCl_{(aq)}$ is added using a burette. The mixture is stirred and once it has stopped fizzing, a further 10.00 cm^3 is added using the burette, no further fizzing is observed.

Step 2
25.0 cm^3 of the resulting solution are removed using a pipette and placed in a conical flask, together with 3 drops of phenolphthalein indicator.

Step 3
A solution of 0.500 mol/dm^3 $NaOH_{(aq)}$ is added to a burette and it is found that 10.15 cm^3 is required to reach the end point.

Worked Example – Finding %purity

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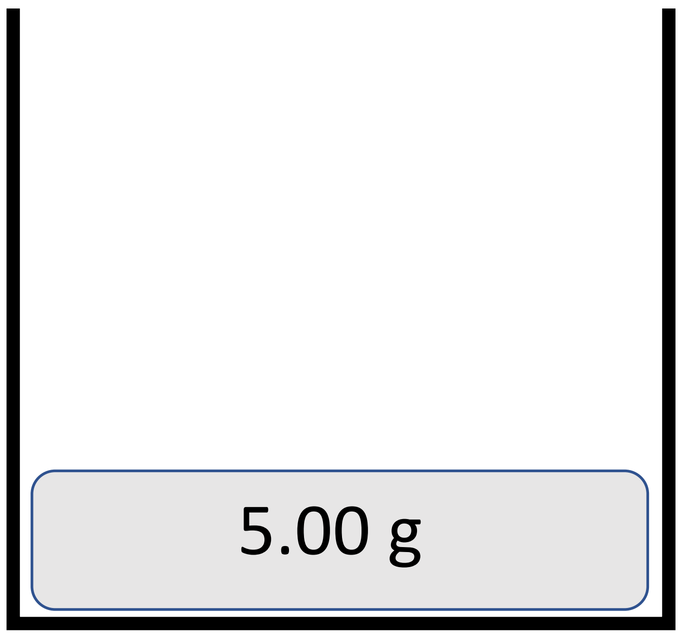

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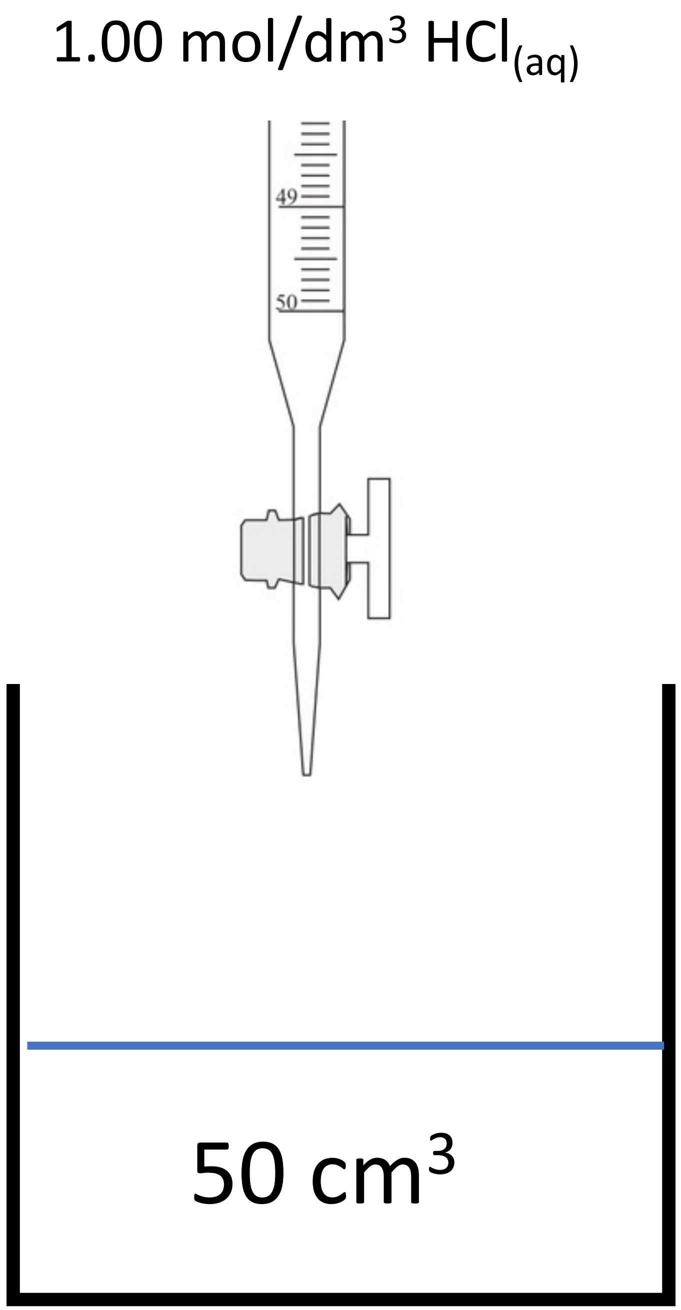

Step 1

5.00 g of the impure calcium carbonate is placed in a beaker.

50.00 cm^3 of 1.00 mol/dm^3 $HCl_{(aq)}$ is added using a burette.

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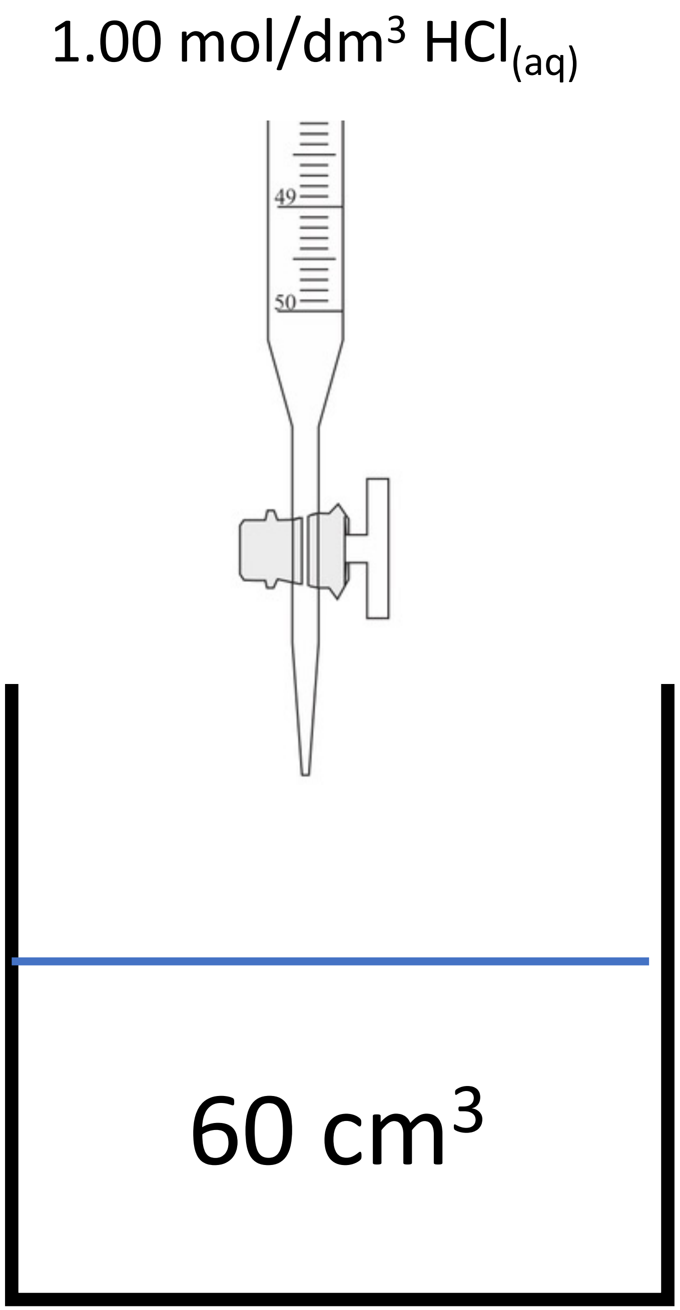


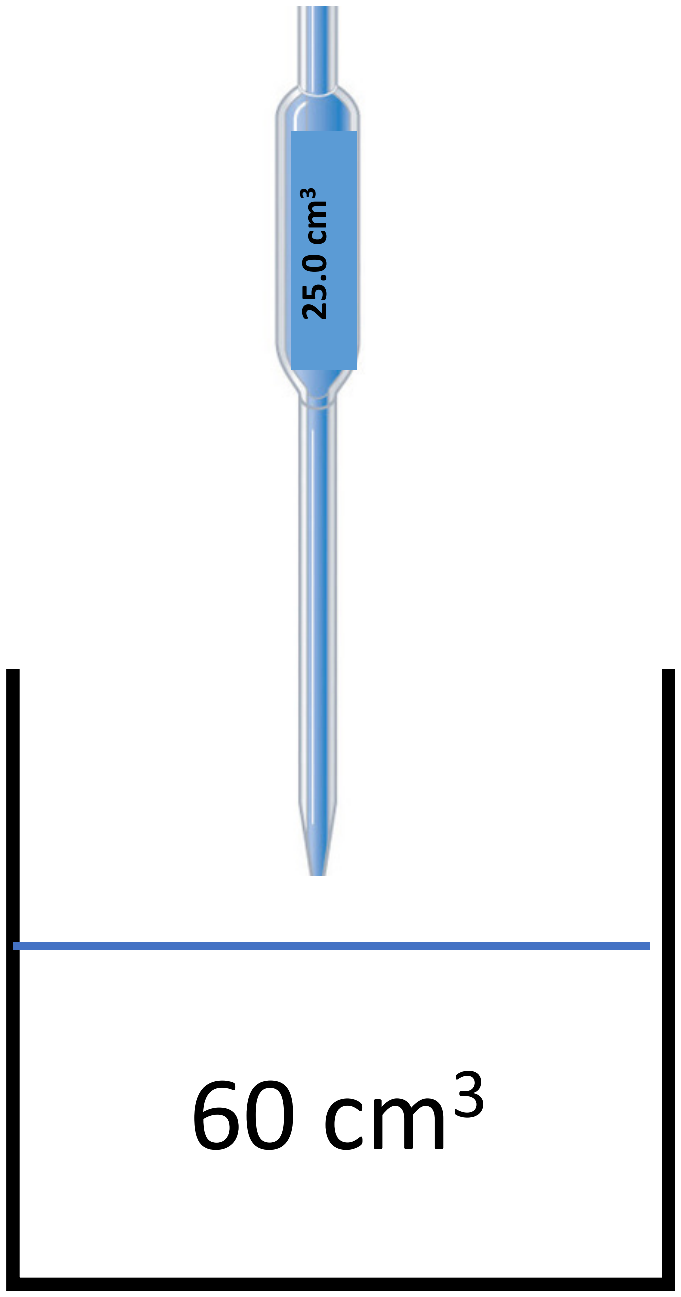
Total number of moles of HCl added = Concentration x Vol (dm^3)

= 1.00 x 0.0600

= **0.0600 moles**

Step 2

25.0 cm³ of the resulting solution are removed using a pipette, placed in a conical flask, together with 3 drops of phenolphthalein indicator.



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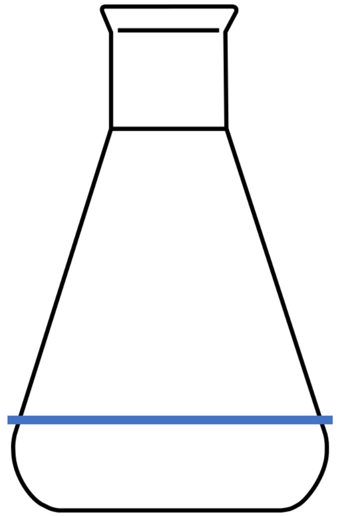

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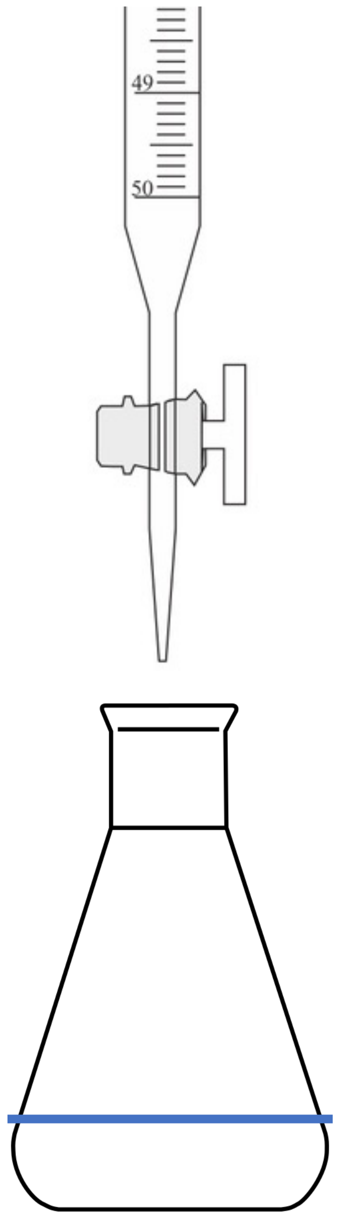
0.500 mol/dm^3 $NaOH_{(aq)}$



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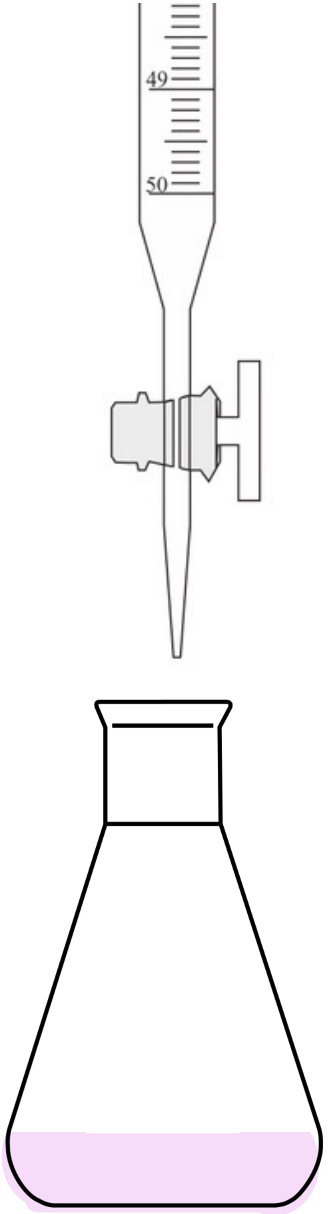

Moles of NaOH = 0.500 x 0.01015 = 0.005075 moles

$$HCl_{(aq)} + NaOH_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$$

Moles of HCl in 25.0 cm^3 = 0.005075 moles

Moles of HCl in 60.0 cm^3 = $\frac{0.005075}{25.0}$ x 60.0 **= 0.01218 moles**

Total number of moles of HCl added = **0.0600 moles**

Moles of HCl remaining after reacting with $CaCO_3$ = **0.01218 moles**

Moles of HCl that reacted with $CaCO_3$ = 0.0600 – 0.01218 = **0.04782**

$$CaCO_{3(s)} + 2HCl_{(aq))} \rightarrow CaCl_{2(aq)} + H_2O_{(l)} + CO_2$$

Moles of $CaCO_3$ = $\frac{0.04782}{2}$ = 0.02591 moles

Mass of $CaCO_3$ = 0.02591 x 100.1 = **2.59 g**

% purity of $CaCO_3$ = $\frac{2.59}{5.00}$ x 100 = **51.9 %**