# Direct titration calculations

OCR A H032 and H432 · AS and A level

Answer on your own paper. Show your working where needed.

### 1. Use the repeat readings

A trainee records a rough titre of 23.60 $cm^3$. The subsequent titres are 23.30, 23.35, 23.80 and 23.40 $cm^3$.

Select the precise repeat results that are within 0.10 $cm^3$ of one another. Calculate their mean to two decimal places and explain why each other result was left out.

### 2. Sodium hydroxide solution

$HCl + NaOH \rightarrow NaCl + H_2O$. A 25.00 $cm^3$ sample of NaOH is neutralised by 22.40 $cm^3$ of 0.125 mol $dm^{-3}$ HCl. Calculate the NaOH concentration in mol $dm^{-3}$.

### 3. Sulfuric acid solution

$H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2H_2O$. A 20.00 $cm^3$ portion of $H_2SO_4$ requires 24.80 $cm^3$ of 0.150 mol $dm^{-3}$ KOH. Calculate the $H_2SO_4$ concentration in mol $dm^{-3}$.

### 4. Predict the volume needed

Nitric acid neutralises calcium hydroxide to form calcium nitrate and water. Write the balanced symbol equation.

Calculate the volume in $cm^3$ of 0.0800 mol $dm^{-3}$ $HNO_3$ needed to neutralise 25.0 $cm^3$ of 0.0160 mol $dm^{-3}$ $Ca(OH)_2$.

### 5. Concentration from a standard solution

A student dissolves 1.325 g of pure $Na_2CO_3$ and makes the solution up to 250.0 $cm^3$. A 25.00 $cm^3$ portion requires 21.60 $cm^3$ of HCl.

$Na_2CO_3 + 2HCl \rightarrow 2NaCl + CO_2 + H_2O$. $M_r(Na_2CO_3) = 106.0$. Calculate the concentration of HCl.

### 6. The original acid

A 10.00 $cm^3$ sample of vinegar is diluted to 100.0 $cm^3$. A 25.00 $cm^3$ portion of the diluted vinegar needs 18.60 $cm^3$ of 0.1000 mol $dm^{-3}$ NaOH.

Ethanoic acid reacts 1:1 with NaOH. Calculate the acid concentration in the original vinegar.

### 7. Finding an unknown molar mass

A 0.4200 g sample of a pure diprotic acid is dissolved and made up to 100.0 $cm^3$. A 25.00 $cm^3$ portion requires 20.00 $cm^3$ of 0.1250 mol $dm^{-3}$ NaOH.

$H_2A + 2NaOH \rightarrow Na_2A + 2H_2O$. Calculate the molar mass of $H_2A$.

### 8. A missed end point

Standard NaOH in a burette is used to find the concentration of 25.00 $cm^3$ of HCl. A student adds one drop beyond the end point and uses that titre.

State whether the calculated HCl concentration is too high, too low or unchanged. Explain your answer using the measurements and the amounts of substance.

### 9. Extra challenge · Report a cleaner’s concentration

10.00 $cm^3$ of a sodium carbonate cleaner is diluted to 250.0 $cm^3$. 25.00 $cm^3$ portions are titrated with 0.1250 mol $dm^{-3}$ HCl. The rough result is 18.40 $cm^3$. Further titres are 17.80, 17.85 and 18.15 $cm^3$. Accept repeat titres within 0.10 $cm^3$.

Write the equation for complete neutralisation. Select the readings to use and calculate the original concentration in g $dm^{-3}$. $M_r(Na_2CO_3) = 106.0$. Explain why rinsing the conical flask with distilled water does not change the required titre.

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