

## Thermometric titration

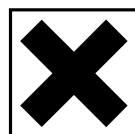
### Your task

You will use thermometric titration to determine the concentration of hydrochloric acid. Neutralisation is an exothermic reaction and the maximum temperature is reached at the end-point.



To gain full marks, you should:

- complete the experiment without guidance (but remember – **always** ask for help if you need it);
- work carefully and safely, making accurate measurements and detailed observations; and
- record all your results clearly in an appropriate way.



Use the following reagents in your experiment:

- 1.000M sodium hydroxide solution
- approx. 2M hydrochloric acid

### Method

1. Read through the Methods, then construct suitable blank tables for your Results.
2. Transfer 50cm<sup>3</sup> of sodium hydroxide solution to a polystyrene cup. Allow it to stand for a few minutes, then record the temperature of the solution.
3. Add 5.0cm<sup>3</sup> of hydrochloric acid from a burette to the cup. Immediately stir the mixture with the thermometer and record its temperature. Repeat until you have added a total of 50.0cm<sup>3</sup> of acid.

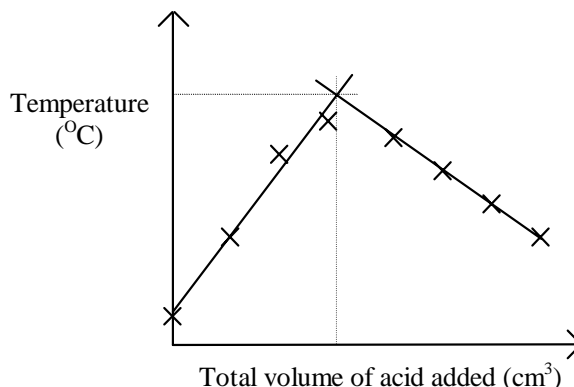
### Analysis

1. Plot a graph of temperature (vertical axis) against total volume of acid added (horizontal axis).

Draw straight lines of best fit and extend them until they cross (see diagram right).

The point at which the two lines meet corresponds to the volume of acid needed for neutralisation and to the maximum temperature.

2. Use information from your graph to calculate the concentration of the acid.



### Evaluation

Comment on your results, their accuracy, and the likely sources of error in the experiment. Consider the limitations of the experiment, and possible improvements to it.

## Thermometric titration

### Technician's Notes

#### Per pupil:

1 x polystyrene cup  
1 x burette and stand  
1 x 25cm<sup>3</sup> pipette  
1 x pipette filler  
1 x plastic filter funnel  
1 x thermometer

#### Per class:

sodium hydroxide solution: 1.000M (allow about 200cm<sup>3</sup> per student)  
hydrochloric acid: 2M approx. (allow about 150cm<sup>3</sup> per student)  
ethanoic acid: 2M approx. (allow about 150cm<sup>3</sup> per student)

#### **\*Health and Safety Notes**

##### **Hydrochloric acid**

Corrosive.

Refer to *Hazcards* for correct method to prepare the 2M (approx.) solution.

##### **Ethanoic acid**

Corrosive.

Harmful vapour.

Refer to *Hazcards* for correct method to prepare the 2M (approx.) solution.

##### **Sodium hydroxide solid and solutions**

Sodium hydroxide is very caustic and forms strongly alkaline solutions.

Exercise care in handling - wear gloves and eye protection.

If spilt, wash with a lot of water.