

## Thermometric titration involving dataloggers

### Introduction

The neutralisation reaction,  $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightleftharpoons \text{H}_2\text{O}(\text{l})$ , is an exothermic reaction. A titration in which the temperature is measured as acid is added to base is known as a **thermometric titration**. The maximum temperature is reached at equivalence, and so the concentration of the acid can be found if the concentration of the base is known. If automatic data collection devices are used to record the temperature (and pH) of the mixture during titration, a large number of readings can be obtained relatively easily, and suitable graphs can be plotted using a computer.



### Aims

To determine the concentrations of hydrochloric acid and ethanoic acid by thermometric titration.

### Apparatus

pH electrode	1 x burette and stand	1 x polystyrene cup
datalogger	1 x magnetic stirrer and follower	1.000M sodium hydroxide ☒
temperature probe	1 x pipette filler	2M approx. hydrochloric acid ☒
1 x 25cm <sup>3</sup> pipette	1 x plastic filter funnel	2M approx. ethanoic acid ☒

### Methods

1. Connect temperature probe and the pH probe to the datalogger.  
Connect the datalogger to the computer.  
Ensure that the software is loaded and set to record from both probes.
2. Following the usual procedures, set up the burette with the 2M approx. hydrochloric acid.
3. Using a pipette filler, transfer 50cm<sup>3</sup> of 1.000M sodium hydroxide solution to the polystyrene cup.  
Place the cup on the magnetic stirrer and carefully put in the follower.
4. Arrange the temperature probe and pH probe so that they are mounted above the polystyrene cup with their ends beneath the surface of the liquid. **Make sure that they do touch the follower.**
5. Arrange the burette so that it can deliver acid to the contents of the cup. Turn the stirrer on, then carry out your titration following the procedure described below.
6. Start recording.  
Add 0.5cm<sup>3</sup> of acid. Allow it to mix with the sodium hydroxide solution for about 3 seconds, then take a single reading of the pH and temperature.
7. Repeat step 6 until you have added a total of 50cm<sup>3</sup> of acid.  
Save your file of data.  
**Write down the name of your file for future reference.**
8. Carefully empty the contents of the polystyrene cup, and clean the probes with de-ionised water.  
Repeat the experiment, but using ethanoic acid.

# HCl and NaOH

