A-level Chemistry exemplar for required practical 9

To investigate how pH changes when a weak acid reacts with a strong base:

Investigation of how the pH of a solution of ethanoic acid changes as sodium hydroxide solution is added.

Student sheet

This experiment investigates how the pH of a solution of ethanoic acid changes as sodium hydroxide solution is added.

The results are plotted in a graph which shows the general pattern of how the pH changes when a weak acid reacts with a strong base.

It is necessary initially to calibrate a pH meter so as to give accurate pH values for each pH reading.

Requirements

You are provided with the following:

- two 50 cm^3 burettes
- two funnels
- 100 cm^3 beaker
- deionised (or distilled) water in a wash bottle
- stand and clamp
- pH meter/probe
- 0.100 mol dm^{-3} sodium hydroxide solution
- 0.100 mol dm^{-3} ethanoic acid solution
- standard pH buffer solutions at pH 4.00, 7.00 and 9.20
- stirring rod
- graph paper.

Suggested method

Part 1 Calibrate the pH meter

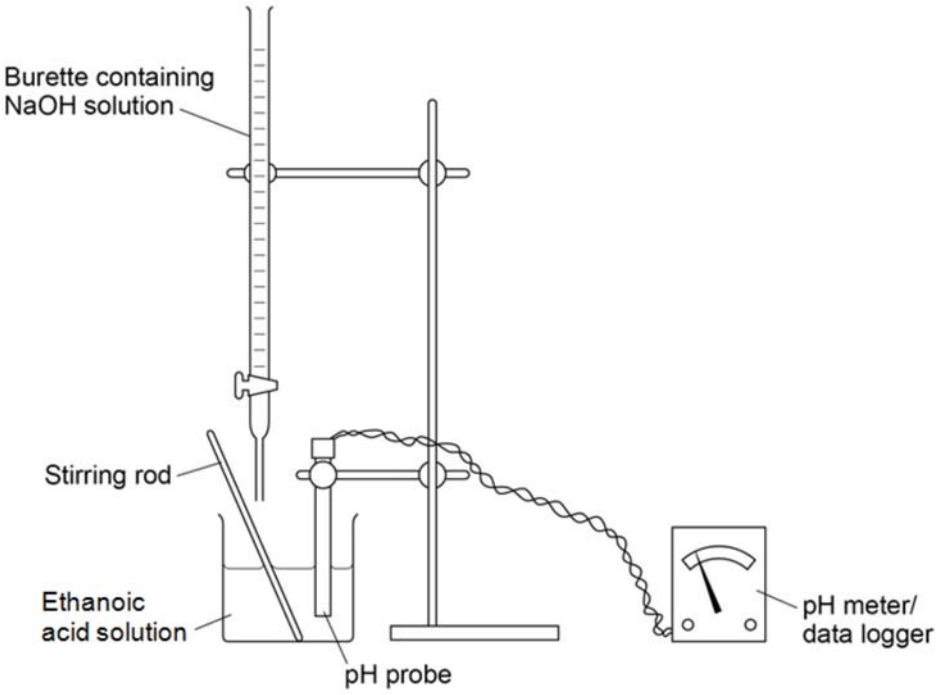
a) Rinse the pH probe thoroughly with deionised water, and shake it gently to remove excess water. Place the probe in the standard pH 7.00 buffer solution provided, ensuring that the bulb is fully immersed. Record the pH reading in a suitable table.

b) Repeat this process using the standard pH 4.00 and 9.20 buffer solutions. Rinse the pH probe thoroughly with deionised water before taking each reading. Record the pH readings in your table.

c) Plot a graph of your recorded pH reading (*x*-axis) against the pH of the buffer solution. Your graph may be a straight line or a curve.This calibration graph will be used in the next part of the experiment to convert pH readings into more accurate pH values.

Part 2 The measurement of the pH of the mixture of acid and alkali

a) Rinse a burette with the 0.100 mol dm^{-3} solution of ethanoic acid provided and then fill the burette with this solution, ensuring that it is filled below the tap. Label this burette so that you do not confuse it with the second burette.
b) Use the burette to transfer exactly 20.0 cm^3 of ethanoic acid to a clean 100 cm^3 beaker.
c) Rinse a second burette with the 0.100 mol dm^{-3} NaOH solution provided and then fill this second burette with this solution, ensuring that it is filled below the tap.
d) Rinse the pH probe with distilled or deionised water and clamp it so that its bulb is fully immersed in the ethanoic acid solution in the beaker. Use a rod to stir the solution gently and record the pH reading in a suitable table.



e) Using the second burette, add exactly 2.0 cm^3 of the NaOH solution to the beaker containing the ethanoic acid. Stir the mixture gently with the glass rod and measure the pH of the mixture. Record the pH reading.
Add the NaOH solution in 2.0 cm^3 portions from the second burette to the ethanoic acid in the beaker until 18 cm^3 of the NaOH solution have been added. Take a pH reading after each addition of NaOH solution, and in each case record the pH reading in your table.
Then add the NaOH solution in 0.20 cm^3 portions until 22.0 cm^3 is reached.
Then add the NaOH solution in 2.0 cm^3 portions again until 40 cm^3 have been added.
f) Rinse the pH probe with distilled or deionised water when you have taken all of your readings.

Analysing the data

a) Use your calibration graph from Part 1 to adjust, as appropriate, the pH readings obtained in your experiment in Part 2. These corrected pH values should be entered into a new column in your table of results.
b) Plot a graph of the corrected pH values from Part 2 (*y*-axis) against volume of sodium hydroxide solution added.
c) Join the points in the most appropriate way.
d) Comment on the shape of the curve.