



A2 4.3/A

# FINDING $K_a$ FOR A WEAK ACID



Aim You are going to find the acid dissociation constant for a weak acid ( $K_a$ ).

Background The dissociation constant for a weak monoprotic acid, HA, is expressed as:  $K_a = \frac{[H^+][A^-]}{[HA]}$

If a weak acid, HA, is titrated against a strong base, such as NaOH, then when exactly half of the acid has been neutralised (at half equivalence),  $[A^-] = [HA]$  and so the pH of the solution equals the  $pK_a$  of the acid.

$$K_a = [H^+] \quad \therefore pK_a = pH$$

Such a solution arises during a titration when the acid in the conical flask is exactly half neutralised by the alkali added from the burette.

A convenient method for determining the dissociation constant of a weak acid involves titrating the acid against an alkali and finding the end point using an indicator. The experiment is then repeated but only half the volume of alkali is added and the pH measured using a pH probe.

- Method
- 1) Calibrate a pH probe in two buffer solutions and then store in a tube of distilled water.
  - 2) Place 25 cm<sup>3</sup> of your 0.100 mol dm<sup>-3</sup> weak acid into a conical flask with a pipette.
  - 3) Add phenolphthalein as indicator.
  - 4) Add 0.100 mol dm<sup>-3</sup> from the burette to find the end point.
  - 5) Repeat the titration without indicator and add half enough sodium hydroxide to neutralise half the acid (i.e. half the volume needed for full neutralisation).
  - 6) Measure the pH of this half neutralised solution.

- Results
- 1) Record the pH of the half neutralised acid.  
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  - 2) Calculate the  $K_a$  of ethanoic acid. ....  
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- Evaluation
- 3) How could you check the reliability of this experiment? .....  
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  - 4) The literature value for the  $K_a$  of ethanoic acid is  $1.74 \times 10^{-5}$  mol dm<sup>-3</sup>. Calculate the difference between your value and this value as a percentage and comment on the accuracy of your result.  
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  - 5) If you had overshoot your original end point, how would it affect your  $K_a$  value. Explain your answer.  
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