Chemistry

Higher level

Paper 1B

Practice paper

Topic: Acid/Base Chemistry

Chemistry

Higher level

Paper 1B

Specimen paper

45 minutes

Instructions to candidates

- Answer all questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for paper 1B is [25 marks].

Section B

1. A student plans to prepare a buffer solution with a pH of 4.50 using a 0.200 mol dm^{-3} solution of ethanoic acid, $CH_3COOH(aq)$, and solid sodium ethanoate, $CH_3COONa(s)$. The pK_a of ethanoic acid at 298 K is 4.76.

(a) Calculate the required ratio of $[CH_3COO^-]$ to $[CH_3COOH]$ to achieve the target pH. **[2]**

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(b) Calculate the mass of solid sodium ethanoate (M = 82.03 g mol^{-1}) that must be added to 500 cm^3 of the ethanoic acid solution to yield this buffer. Assume the volume does not change upon adding the solid. **[3]**

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(c) Formulate equations to show how this buffer solution responds to the addition of a small amount of strong acid, $H^+(aq)$, and a strong base, $OH^-(aq)$. **[2]**

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(d) State how diluting this buffer solution with an equal volume of distilled water would affect its pH and its buffer capacity. **[2]**

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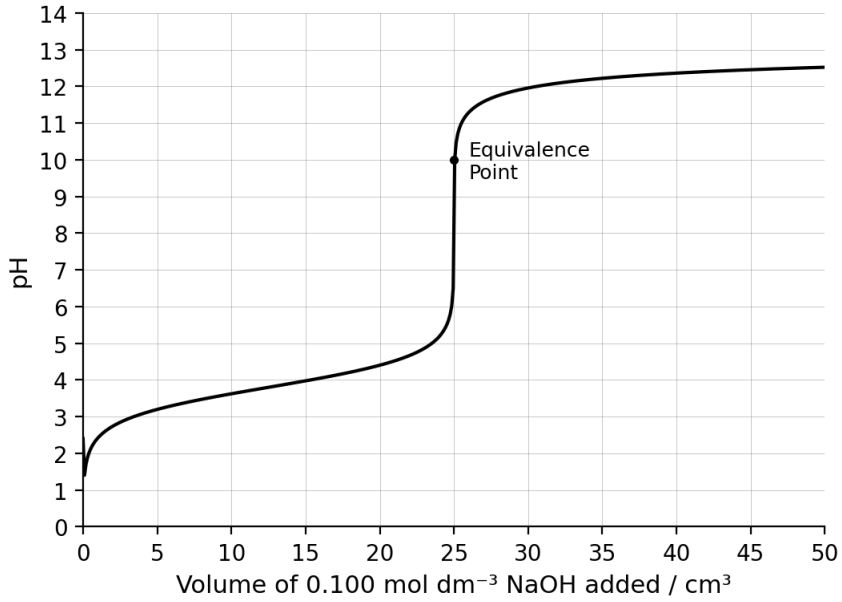
2. A student titrates a 25.0 cm^3 solution of a weak acid, HA(aq), with 0.10 mol dm^{-3} NaOH(aq). The titration curve is shown below. The equivalence point occurs when 25.0 cm^3 of NaOH(aq) is added.



(a) Determine the pK_a of the weak acid using the titration curve, clearly stating your method. **[2]**

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(b) Calculate the value of the acid dissociation constant, K_a. **[1]**

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(c) Justify why the pH at the equivalence point is approximately 8.3 rather than 7.0, using a balanced chemical equation. **[2]**

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3. An aqueous solution of methylamine, $CH_3NH_2(aq)$, has a concentration of 0.050 mol dm^{-3} and a measured pH of 11.52 at 298 K.

(a) Write the equation for the reaction of methylamine with water. **[1]**

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(b) Calculate the concentration of hydroxide ions, $[OH^-]$, in the solution at equilibrium. **[1]**

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(c) Calculate the base dissociation constant, K_b, for methylamine, outlining any assumptions made. **[3]**

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