Acid/Base Equilibria

Question Paper

Level	International A Level
Subject	Chemistry
Exam Board	Edexcel
Topic	Rates, Equilibria & Further Organic Chemistry
Sub Topic	Acid/Base Equilibria
Booklet	Question Paper

Time Allowed: **40 minutes**

Score: /33

Percentage: /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 Titrations were carried out using aqueous solutions with concentration 1.0 mol dm^{-3}. The titration curves below were obtained.
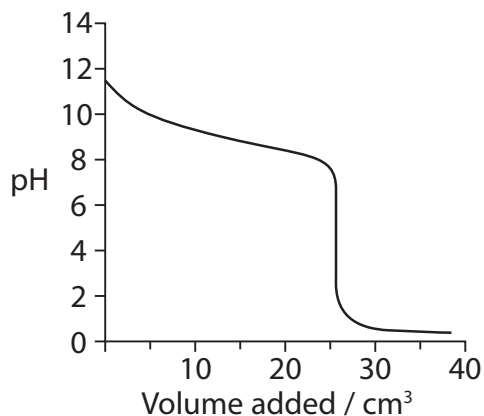
A
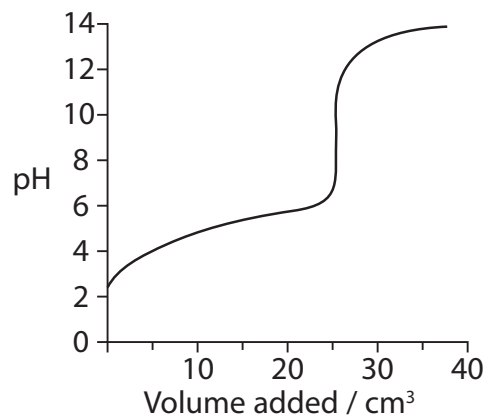
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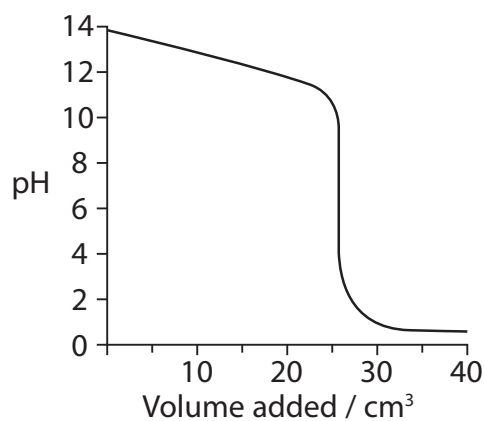
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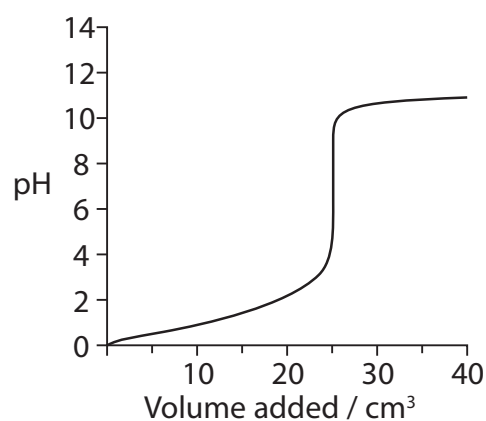
D

(a) Which curve would be obtained for the titration in which hydrochloric acid is added to aqueous ammonia?

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(b) For which titration would methyl orange **not** be a suitable indicator? Use the data on page 19 of the Data Booklet.

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(Total for Question 1 = 2 marks)

2 When a small amount of hydrochloric acid is added to a buffer solution, the change in pH is very small.

What is the best explanation for this?

☒ **A** The dissociation of the acid in the buffer solution is small.

☒ **B** The concentration of the buffer solution only changes a little.

☒ **C** The ratio of the concentration of acid to conjugate base in the buffer solution does not change.

☒ **D** The ratio of the concentration of acid to conjugate base in the buffer solution only changes a little.

(Total for Question 2 = 1 mark)

3 Which of the following solutions, when mixed, would make a buffer with pH greater than 7?

☒ **A** Ethanoic acid and sodium ethanoate.

☒ **B** Sodium hydroxide and sodium chloride.

☒ **C** Ammonia and sodium chloride.

☒ **D** Ammonia and ammonium chloride.

(Total for Question 3 = 1 mark)

4 Propanoic acid is a weak Brønsted-Lowry acid.

(a) Define the term Brønsted-Lowry acid.

(1)

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(b) What is the pH of a 0.100 mol dm^{-3} solution of hydrochloric acid?
How would the pH of any weak acid of the same concentration differ from the pH
of hydrochloric acid?

(1)

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(c) Methanoic acid was mixed with propanoic acid.

(i) Use your Data Booklet to decide which acid is stronger.
Justify your answer.

(1)

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(ii) Hence complete the following equation.

(1)

$HCOOH + C_2H_5COOH \rightleftharpoons$ .... $+$ ....

(d) Calculate the pH of a solution of 0.050 mol dm^{-3} sodium hydroxide.

$[K_w = 1.0 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6}]$

(2)

(e) A buffer was made by mixing 20 cm^3 of 0.050 mol dm^{-3} sodium hydroxide and 20 cm^3 of 0.25 mol dm^{-3} propanoic acid.

  (i) Write the equation for the reaction between sodium hydroxide and propanoic acid. State symbols are not required.

(1)

  (ii) Calculate the pH of this buffer solution. Show your working. Refer to your Data Booklet where needed.

(5)

(iii) Explain how this solution acts as a buffer when a small amount of **alkali** is added. Include any relevant equations in your explanation.

(3)

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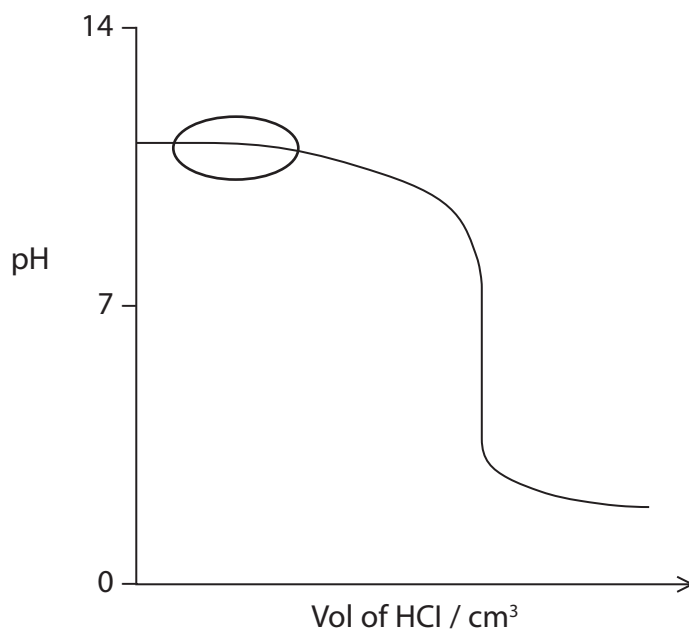
(Total for Question 4 = 15 marks)

5 A student carried out a titration by adding 0.0540 mol dm^{-3} hydrochloric acid to 25.0 cm^3 of 0.0240 mol dm^{-3} ammonia solution. A sketch graph of pH against volume of hydrochloric acid added is shown below.

(a) *(i) Name the type of solution formed in the region ringed on the sketch graph and explain its chemical behaviour.

(3)

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*(ii) Explain why the pH at the equivalence point of this titration is less than 7. Include an ionic equation in your answer.

(3)

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(iii) By considering the amount of excess acid remaining, calculate the pH of the solution formed when 40.0 cm^3 of 0.0540 mol dm^{-3} hydrochloric acid has been added to 25.0 cm^3 of 0.0240 mol dm^{-3} ammonia solution.

(4)

(b) (i)   Show, using the data below, that the pH of water at 373 K is 6.13.

- $H_2O(l) \rightleftharpoons H^+(aq) + OH^-(aq)$

- $K_w = 5.50 \times 10^{-13}$ mol^2 dm^{-6} at 373 K

(2)

(ii) At 373 K, is water neutral, acidic or alkaline? Explain your answer.

(2)

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(Total for Question 5 = 14 marks)