P525/1

CHEMISTRY

PAPER 1

$1\frac{3}{4}$ **Hours**

UGANDA ADVANCED CERTIFICATE OF EDUCATION

TOPICAL EXAMINATION 2024
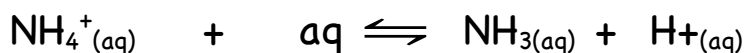
TOPIC: **IONIC EQUILIBRIA**

SUB-TOPIC: **Acids, bases and salts**

1Hour: 45min

INSTRUCTIONS TO CANDIDATES:

Answer all questions in this paper

1. (a) Ammonium chloride undergoes hydrolysis when dissolved in water according to the equation

$$NH_4^+{}_{(aq)} \ + \ aq \rightleftharpoons NH_{3(aq)} + H^+{}_{(aq)}$$

If the hydrolysis constant for ammonium chloride, K_h, at 25°C is 5.6×10^{-10}, Calculate

(i) the pH of a 0.1M solution of ammonium chloride.

(03 marks)

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(ii) the percentage hydrolysis of 0.1M solution of ammonium chloride   (02 marks)

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(b) (i) Write an equation for the hydrolysis of sodium ethanoate in water   (01 mark)

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(ii) Write an expression for the hydrolysis constant, K_h of sodium ethanoate.   (01 mark)

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(c) Calculate:

(i) the value of Kh for sodium ethanoate and indicate its units. (K_a for CH_3COOH is 1.8×10^{-5} ; $K_w = 1 \times 10^{-4}$) (2 ½ marks)

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(ii) the pH of 0.1M sodium ethanoate solution. (03 marks)

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(d) state what would be the effect on the pH of the solution in c(ii) if 1 cm^3 of 0.1M ethanoic acid was added to it

(01 mark)

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2. (a) Write an expression for pH.   (01 mark)

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(b)   (i) Calculate the pH of a 0.05M solution of sodium hydroxide. (K_w =1 $\times$ 10^{-14} M)   (02 marks)

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(ii) State the effect of dilution on the pH of sodium hydroxide solution. Give a reason for your answer. (02 mark)

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(c) Propanoic acid is a weak acid.

(i) Write the equation for the ionisation of the propanoic acid in water   (01 mark)

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(ii) Write the expression for the ionisation constant Ka for the acid.   (01 mark)

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(iii) Calculate the pH of a 0.25M solution of the acid
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(d) Which one of ethanoic acid and Chloroethanoic acid is a stronger acid? Explain your answer. (03 marks)

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3. (a) Sodium hydroxide solution was added to 25cm³ of 0.1M ethanoic acid and the pH of the solution was measured at intervals. The results are given in the table below.

Volume of NaOH (Cm³)	0	4	8	12	16	20	22	22.5	23	24	28
pH of the mixture	2.8	3.5	4.0	4.5	5.1	5.8	7.0	9.0	10.5	11.4	12.3

(i) Plot a graph of pH against volume of sodium hydroxide. (03 marks)

(ii) Explain the shape of the curve. (04 marks)

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(iv) Determine the pH at the end point.   (01 mark)

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(iv) Calculate the molarity of the sodium hydroxide solution   (03 marks)

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(v) Determine the dissociation constant, K_a, of the ethanoic acid used.   (03 marks)

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4. (a) A solution containing 0.001mol dm^{-3} of methanoic acid is 1% ionised. Calculate:

(i) the pH of methanoic acid solution.   (02 marks)

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(ii) the acid dissociation constant K_a, for methanoic acid.
(02 marks)

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(b) (i) write an equation for the hydrolysis of sodium benzoate in water. (01 mark)

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(ii) A solution contains 0.2 moles of sodium benzoate per litre at 25°C. Calculate the pH of the solution. State the assumptions made in your calculation. (The hydrolysis constant of sodium benzoate is 1.6×10^{-10} moldm^{-3}, K_w is 1.0×10^{-14} mol^{2}dm^{-6} at 25°C). (05 marks)

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(b) Explain why an aqueous solution of iron(III) chloride is acidic to litmus   (03 marks)

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5. (a) Calculate the pH of solution formed by mixing 80 cm^3 of 0.1M hydrochloric acid with 120 cm^3 of 0.1M potassium hydroxide. (K_w of water is 1.0×10^{-14}mol^{2}dm^{-6}(05 marks)

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(b) Calculate the pH of a solution made by dissolving 7.2g of aminobenzene in 500cm³ (K_b = 3.5 x 10^{-10}moldm⁻³, C = 12, N = 14, H = 1)   (05 marks)

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6. (a) Dimethylamine partially ionises in water to form an alkaline solution. Write an equation for the ionisation of dimethylamine in water.   (01 mark)

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(b) The pH of a 0.02M dimethylamine solution at 20°C was found to be 11.51.

(i) Calculate the molar concentration of hydroxide ions in the solution. The ionic product of water at 20℃ is 6.81×10^{-15} mol^2dm^{-6} (03 marks)

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(ii) Deduce the basic ionisation constant, of dimethylamine from your answer in b(i) above. (1 ½ marks)

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(c) Explain why for ammonia at 20℃ is lower than the value calculated in b(ii) above. (03 marks)

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