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NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

For Supervisor's use only

Level 3 Chemistry, 2007

90700 Describe properties of aqueous systems

Credits: Five
9.30 am Monday 19 November 2007

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should answer ALL the questions in this booklet.

A periodic table is provided on the Resource Sheet L3–CHEMR.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–9 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

For Assessor's use only	**Achievement Criteria**				
Achievement		**Achievement with Merit**		**Achievement with Excellence**	
Describe properties of aqueous systems.		Explain and apply properties of aqueous systems.		Discuss properties of aqueous systems.	
Overall Level of Performance					

You are advised to spend 45 minutes answering the questions in this booklet.

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QUESTION ONE

(a) (i) For each of the following 0.1 mol L^{-1} solutions, write an equation to show the reaction with water.

CH_3NH_2

NH_4Cl

(ii) List all the species in each of the following 0.1 mol L^{-1} aqueous solutions in order of **decreasing** concentration. **Do not include H_2O.**

CH_3NH_2 _____

NH_4Cl _____

(b) Explain why aqueous aminomethane, CH_3NH_2, is a weak electrolyte.

QUESTION TWO

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The pH of the solution in the stomach of a patient in hospital is 2.50. As a treatment, the patient is given a small volume of sodium citrate (Na_3Cit) solution. Citric acid, H_3Cit, is a triprotic acid.

(a) (i) Would the pH of a solution of sodium citrate be less than, equal to or greater than 7? A calculation is not required.

pH is _____

(ii) Explain your choice, **including an appropriate equation** in your answer.

Magnesium hydroxide (known as **milk of magnesia**) is another substance that the patient consumed to control the acidity of the solution in the stomach.

$$K_s(Mg(OH)_2) = 1.25 \times 10^{-11}$$

(b) (i) Calculate the solubility of magnesium hydroxide in water in mol L^{-1}.

(ii) What is the concentration of Mg^{2+} in 0.150 mol L^{-1} sodium hydroxide, NaOH, solution?

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QUESTION THREE

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An aqueous ammonia solution has a pH of 10 and when phenolphthalein indicator is added it turns pink. Solid ammonium chloride is added to this solution and the solution turns colourless due to a decrease in pH.

By considering the equilibrium systems, discuss why the pH of the solution decreased. **Include a relevant equation** in your answer.

QUESTION FOUR

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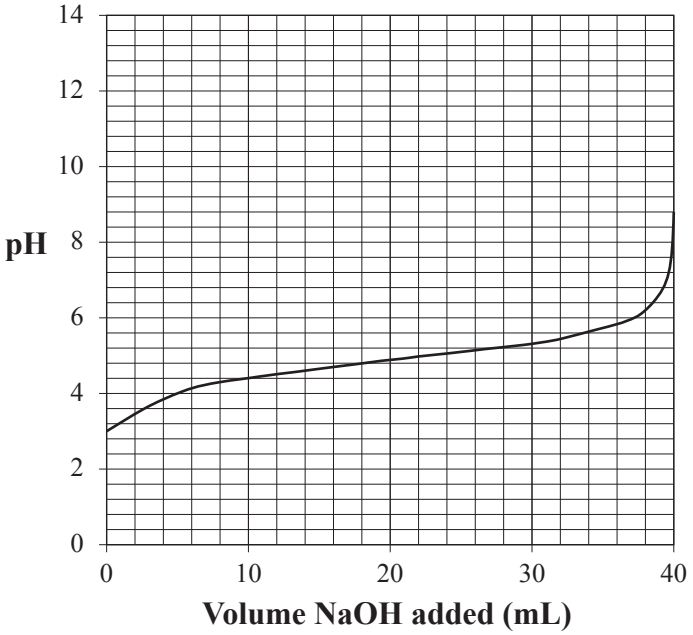
A 0.160 mol L^{-1} solution of sodium hydroxide is titrated against 50 mL of aqueous propanoic acid, HPr. 40 mL of the sodium hydroxide solution was required to exactly react with the propanoic acid.

The reaction occurring can be represented as:

$$HPr(aq) + NaOH(aq) \rightarrow NaPr(aq) + H_2O$$

K_a (HPr) = 1.35×10^{-5}



(a) (i) Show that the concentration of the aqueous propanoic acid is 0.128 mol L^{-1}.

(ii) Calculate the pH of the aqueous propanoic acid.

(b) Calculate the pH at the equivalence point.

(c) 35 mL of the sodium hydroxide solution is added to a second 50 mL sample of the same acid to form a buffer solution.

(i) What is the function of a buffer?

(ii) Discuss the ability of the solution formed to act as a buffer. Your answer should include relevant equations.

(d) The equivalence point of the titration could also be found using an acid-base indicator.

Which of the following indicators would be suitable to use? Explain your choice of indicator.

Indicator	**pK_a**
Methyl orange	3.7
Bromocresol green	4.7
Methyl red	5.0
Thymol blue	8.9
Phenolphthalein	9.3

Indicator(s) _____

Explanation _____

_____

_____

_____

Extra paper for continuation of answers if required.
Clearly number the question.

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Question number	

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