90700

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MANA TOHU MĀTAURANGA O AOTEAROA

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SUPERVISOR'S USE ONLY

Level 3 Chemistry, 2011

90700 Describe properties of aqueous systems

9.30 am Monday 21 November 2011
Credits: Five

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 attempt ALL the questions in this booklet.

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

If you need more room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–10 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.

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) Classify the following 0.100 mol L^{-1} solutions by writing the correct description from the terms below.

strong acid **weak acid** **neutral** **weak base** **strong base**

NH_3 _____

NaCl _____

NH_4Cl _____

HF _____

(b) Discuss the relative concentrations of the species present in each of the 0.100 mol L^{-1} solutions of NH_3 and HF. *You do not need to include water.*

Include in your answer:

- any relevant equations
- a ranking of the species present in each solution in order of **decreasing** concentration
- justification for the ranking of the species.

No calculations are necessary.

(i) NH_3 _____

decreasing order of concentration

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(ii) HF

decreasing order of concentration

(c) A solution prepared by dissolving hydrogen fluoride in water has a pH of 2.34.

Calculate the concentration of the hydrogen fluoride in the solution.

pK_a (HF) = 3.17

QUESTION TWO

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Zinc hydroxide, $Zn(OH)_2$, has a K_s of 3.00×10^{-17} at 25°C.

(a) (i) Write an equation for zinc hydroxide **dissolving** in water.

(ii) Write the K_s expression for zinc hydroxide.

(b) Calculate the solubility (in mol L^{-1}) of zinc hydroxide at 25°C.

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(c) A saturated solution of zinc hydroxide, $Zn(OH)_2$, contains a small amount of solid $Zn(OH)_2$ at the bottom of the container.

The pH of the solution is increased.

Discuss the effect of increasing the pH on the amount of solid present, and also on the nature and concentration of the species present in the solution.

No calculations are necessary.

QUESTION THREE

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Glycolic acid, $HOCH_2COOH$, is a monoprotic acid used in various skin-care products, and can be represented as **HG**. Glycolic acid has a pK_a value of 3.83.

(a) Write an equation for the reaction of glycolic acid, HG, with water.

(b) Write the K_a expression for glycolic acid, HG.

$K_a =$

(c) Calculate the pH of a 0.675 mol L^{-1} solution of glycolic acid, HG.

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(d) Sodium glycolate, the sodium salt of the acid, is also used in skin care. Sodium glycolate can be represented as **NaG**.

Calculate the amount (in moles) of sodium glycolate that must be added to 200 mL of 1.00 mol L^{-1} glycolic acid solution to produce a buffer solution that has a pH of 4.00.

Assume there is no change in volume.

QUESTION FOUR

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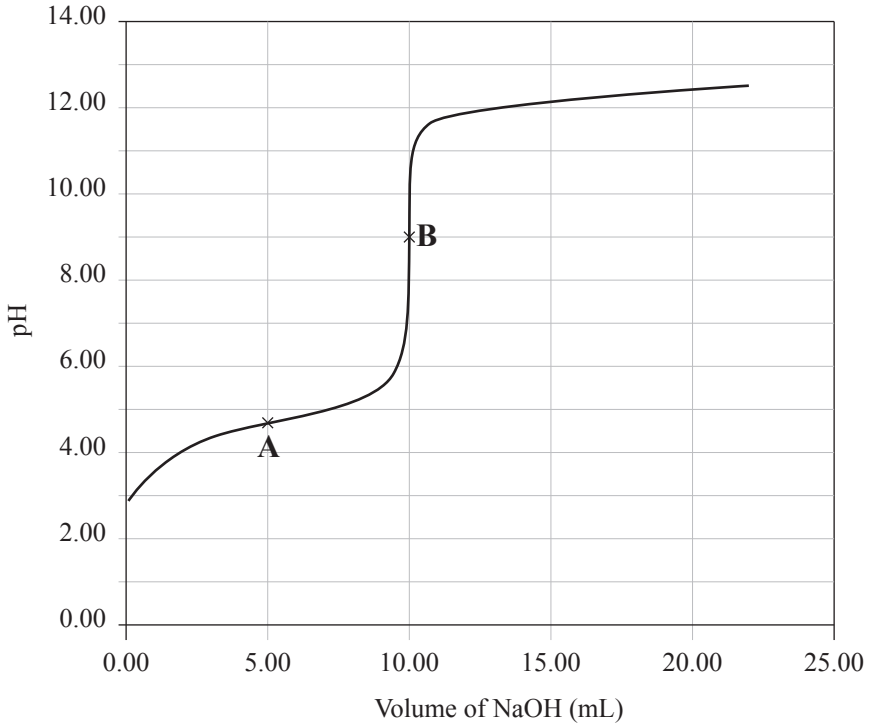
Below is the titration curve for 10.0 mL of 0.100 mol L^{-1} ethanoic acid being titrated with 0.100 mol L^{-1} sodium hydroxide. Ethanoic acid can be represented by the symbol HEt.

Titration of 0.100 mol L^{-1} ethanoic acid, HEt, with 0.100 mol L^{-1} NaOH



(a) With reference to the point marked **A** on the graph, discuss:

- the species present, and their relative concentrations
- an estimate of the pK_a value for ethanoic acid
- the effect of adding small amounts of strong acid or strong base to the solution.

Include relevant equations in your answer.

No calculations are necessary.

(b) With reference to the point marked **B** on the graph, discuss the species present, and their effect on the pH at the equivalence point.

Include relevant equations in your answer.

No calculations are necessary.

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Extra space if required.
Write the question number(s) if applicable.

QUESTION NUMBER

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