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NZQA
NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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SUPERVISOR'S USE ONLY

Level 3 Chemistry, 2013

91392 Demonstrate understanding of equilibrium principles in aqueous systems

2.00 pm Tuesday 19 November 2013
Credits: Five

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of equilibrium principles in aqueous systems.	Demonstrate in-depth understanding of equilibrium principles in aqueous systems.	Demonstrate comprehensive understanding of equilibrium principles in aqueous systems.

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 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 2–10 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.

TOTAL

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You are advised to spend 60 minutes answering the questions in this booklet.

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QUESTION ONE

(a) 1 mol of each of the following substances was placed in separate flasks, and water was added to these flasks to give a total volume of 1 L for each solution.

In the box below, rank these solutions in order of **increasing** pH.

Justify your choice and include equations where appropriate.

CH_3NH_3Cl
CH_3NH_2
HCl

Order of increasing pH

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(b) The conductivity of the 1 mol L^{-1} solutions formed in (a) can be measured.

In the box below, rank these solutions in order of **decreasing** conductivity.

Order of decreasing conductivity

Compare and contrast the conductivity of each of the 1 mol L^{-1} solutions, with reference to species in solution.

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(c) (i) The following two solutions from part (a) are mixed to form a buffer solution:

20.0 mL of 1 mol L^{-1} CH_3NH_3Cl and 30.0 mL of 1 mol L^{-1} CH_3NH_2

Calculate the pH of the resultant buffer solution.

pK_a ($CH_3NH_3^+$) = 10.64

(ii) Explain the effect on the solution formed in (i) when a small amount of acid is added.

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QUESTION TWO

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In an experiment, a saturated solution was made by dissolving 1.44×10^{-3} g of Ag_2CrO_4 in water, and making it up to a volume of 50.0 mL.

$M\,(Ag_2CrO_4) = 332$ g mol^{-1}

(a) Write the K_s expression for $Ag_2CrO_4(s)$.

(b) (i) Calculate the solubility of $Ag_2CrO_4(s)$, and hence give the $[Ag^+]$ and $[CrO_4^{2-}]$ in the solution.

(ii) Determine the $K_s(Ag_2CrO_4)$.

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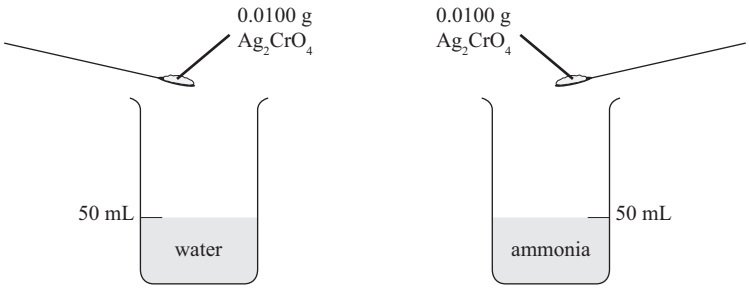
(c) In another experiment, 0.0100 g of Ag_2CrO_4 in beaker A was made up to a volume of 50.0 mL with water. In beaker B, 0.0100 g of Ag_2CrO_4 was made up to a volume of 50.0 mL with 0.100 mol L^{-1} ammonia solution.



Beaker A Beaker B

Compare and contrast the solubility of Ag_2CrO_4 in beaker A and beaker B.

No calculations are necessary.

QUESTION THREE

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20.0 mL of 0.0896 mol L^{-1} ethanoic acid is titrated with 0.100 mol L^{-1} sodium hydroxide.

pK_a (CH_3COOH) = 4.76

(a) Calculate the pH of the ethanoic acid before any NaOH is added.

(b) Halfway to the equivalence point of the titration, the pH = pK_a of the ethanoic acid.

Discuss the reason for this.

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(c) (i) Discuss the change in the concentration of species in solution, as the first 5.00 mL of NaOH is added to the 20.0 mL of ethanoic acid.

Your answer should include chemical equations.

No calculations are required.

(ii) Calculate the pH of the titration mixture after 5.00 mL of NaOH has been added.

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

QUESTION NUMBER

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