

91392



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## Level 3 Chemistry, 2016

### 91392 Demonstrate understanding of equilibrium principles in aqueous systems

2.00 p.m. Monday 21 November 2016  
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 in the Resource Sheet L3-CHEMR.

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

Check that this booklet has pages 2–8 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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**QUESTION ONE**

Silver carbonate,  $\text{Ag}_2\text{CO}_3$ , is a sparingly soluble salt.

$$K_s(\text{Ag}_2\text{CO}_3) = 8.10 \times 10^{-12} \text{ at } 25^\circ\text{C} \quad M(\text{Ag}_2\text{CO}_3) = 276 \text{ g mol}^{-1}$$

- (a) Write the solubility product expression,  $K_s$ , for silver carbonate ( $\text{Ag}_2\text{CO}_3$ ).

- (b) Calculate the mass of  $\text{Ag}_2\text{CO}_3$  that will dissolve in 50 mL of water to make a saturated solution at  $25^\circ\text{C}$ .

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- (c) Explain how the solubility of  $\text{Ag}_2\text{CO}_3$  will change if added to 50 mL of a  $1.00 \text{ mol L}^{-1}$  ammonia,  $\text{NH}_3$ , solution.

Support your answer with balanced equations.

*No calculations are necessary.*

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- (d) Show by calculation whether a precipitate of  $\text{Ag}_2\text{CO}_3$  will form when 20.0 mL of  $0.105 \text{ mol L}^{-1}$  silver nitrate,  $\text{AgNO}_3$ , solution is added to 35.0 mL of a  $0.221 \text{ mol L}^{-1}$  sodium carbonate,  $\text{Na}_2\text{CO}_3$ , solution.

$$K_s(\text{Ag}_2\text{CO}_3) = 8.10 \times 10^{-12} \text{ at } 25^\circ\text{C}$$

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**QUESTION TWO**

Ethanamine,  $\text{CH}_3\text{CH}_2\text{NH}_2$ , is a weak base.

$$\text{p}K_a(\text{CH}_3\text{CH}_2\text{NH}_3^+) = 10.6 \quad K_a(\text{CH}_3\text{CH}_2\text{NH}_3^+) = 2.51 \times 10^{-11}$$

- (a) Write an equation to show the reaction of ethanamine with water.

- (b) Calculate the pH of a  $0.109 \text{ mol L}^{-1}$  solution of ethanamine.

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- (c) Ethyl ammonium chloride,  $\text{CH}_3\text{CH}_2\text{NH}_3\text{Cl}$ , is a weak acid that will also react with water.

List all the species present in a solution of  $\text{CH}_3\text{CH}_2\text{NH}_3\text{Cl}$ , in order of decreasing concentration.

Do not include water.

Justify the order you have given.

Include equations, where necessary.

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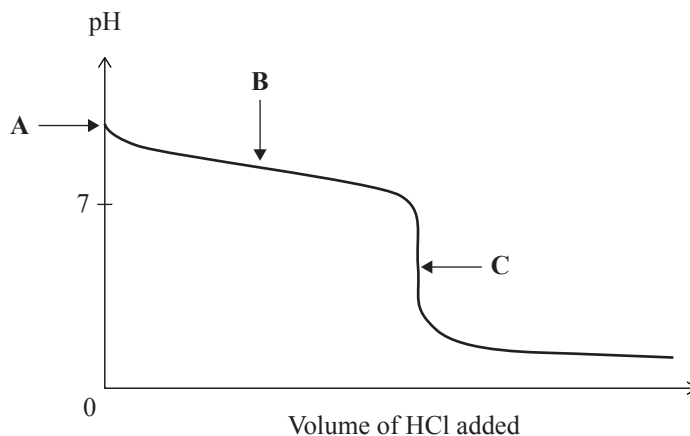
**QUESTION THREE**

20.00 mL of 0.320 mol L<sup>-1</sup> ammonia, NH<sub>3</sub>, is titrated with 0.640 mol L<sup>-1</sup> hydrochloric acid, HCl.

The equation for this reaction is:



The curve for this titration is given below.



- (a) Explain why the pH at the equivalence point (point C) is not 7.

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- (b) Show, by calculation, that the pH at the equivalence point (point C) is 4.96.

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- (c) Explain, in terms of the species present, why the pH at B (half way to the equivalence point) is 9.24.

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- (d) Explain, in terms of the species present, why the pH of the solution at point C is 4.96.  
*No calculations are necessary.*

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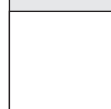
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**Extra paper if required.  
Write the question number(s) if applicable.**

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QUESTION  
NUMBER

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