3

SUPERVISOR'S USE ONLY

91392



# 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	Demonstrate in-depth understanding of equilibrium principles in aqueous	Demonstrate comprehensive understanding of equilibrium principles		
systems.	systems.	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

### **QUESTION ONE**

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Silver carbonate,  $Ag_2CO_3$ , is a sparingly soluble salt.

$$K_{\rm s}({\rm Ag_2CO_3}) = 8.10 \times 10^{-12} \text{ at } 25^{\circ}{\rm C}$$
  $M({\rm Ag_2CO_3}) = 276 \text{ g mol}^{-1}$ 

(a) Write the solubility product expression, $K_s$ , for silver carbonate (Ag <sub>2</sub> CO <sub>3</sub> )	(a)	Write the	solubility	product	expression,	$K_{\varsigma}$	for s	ilver	carbonate	$(Ag_2C)$	$(O_3)$	).
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)	Calculate the mass of Ag <sub>2</sub> CO <sub>3</sub> that will dissolve in 50 mL of water to make a saturated solution at 25°C.				

)	Explain how the solubility of Ag <sub>2</sub> CO <sub>3</sub> will change if added to 50 mL of a 1.00 mol L <sup>-1</sup> ammonia, NH <sub>3</sub> , solution.	ASSES USE (
	Support your answer with balanced equations.	
	No calculations are necessary.	
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	Show by calculation whether a precipitate of $Ag_2CO_3$ will form when 20.0 mL of 0.105 mol L <sup>-1</sup> silver nitrate, $AgNO_3$ , solution is added to 35.0 mL of a 0.221 mol L <sup>-1</sup> sodium carbonate, $Na_2CO_3$ , solution.	
	$K_{\rm s}({\rm Ag_2CO_3}) = 8.10 \times 10^{-12} \text{ at } 25^{\circ}{\rm C}$	
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## **QUESTION TWO**

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Ethanamine,  $CH_3CH_2NH_2$ , is a weak base.

$$pK_a(CH_3CH_2NH_3^+) = 10.6$$
  $K_a(CH_3CH_2NH_3^+) = 2.51 \times 10^{-11}$ 

(a)	Write an	equation t	o show	the rea	ction o	of ethana	amine	with	water.
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(b)	Calculate the	pH of a	0.109	$mol L^{-1}$	solution	of ethar	namine.
(0)	Carcarate tire	prioru	0.10)	mor L	Solution	or cultur	iuiiiiii.

List all the species pres concentration.	sent in a solution of CH <sub>3</sub> C	CH <sub>2</sub> NH <sub>3</sub> Cl, in order of decreasing	
Do not include water.			
Justify the order you ha	ave given.		
Include equations, whe			

#### **QUESTION THREE**

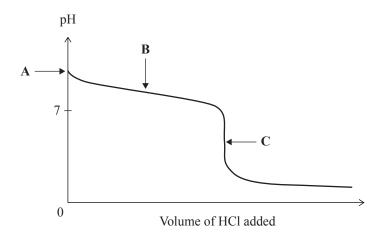
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20.00~mL of 0.320~mol L $^{-1}$  ammonia,  $NH_3$ , is titrated with 0.640~mol L $^{-1}$  hydrochloric acid, HCl.

The equation for this reaction is:

$$NH_3 + HC1 \rightarrow NH_4^+ + C1^ pK_a(NH_4^+) = 9.24$$

The curve for this titration is given below.



(-)	T1-:	1 41	T T _ 4 41	equivalence		( : 4	$\alpha$ : -	4 7
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(u)	LAPIGIII	vv 11 y till	pri at the	equivalence	POIII	pomi	$\sim$ $^{10}$	1100 /

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

xplain, in terms of the species present, why the pH of the solution at point C is <i>To calculations are necessary</i> .	4.96.

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	Extra paper if required.		
OUESTION		Write the question number(s) if applicable.	
QUESTION NUMBER			_