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91392



Level 3 Chemistry, 2015

91392 Demonstrate understanding of equilibrium principles in aqueous systems

2.00 p.m. Wednesday 11 November 2015 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 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 and clearly number the question.

Check that this booklet has pages 2–11 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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 $Methylammonium\ chloride,\ CH_3NH_3Cl,\ dissolves\ in\ water\ to\ form\ a\ weakly\ acidic\ solution.$

$$K_a(\text{CH}_3\text{NH}_3^+) = 2.29 \times 10^{-11}$$

a)	(i)	Write an equation to show CH ₃ NH ₃ Cl dissolving in water.			
	(ii)	Write an equation to show the reaction occurring in an aqueous solution of CH ₃ NH ₃ Cl.			
	(iii)	List all the species present in an aqueous solution of CH ₃ NH ₃ Cl, in order of decreasing			
	(111)	concentration.			
		Do not include water.			
	(iv)	Calculate the pH of $0.0152 \text{ mol } L^{-1} \text{ CH}_3 \text{NH}_3 \text{Cl solution}$.			

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(b) The table shows the pH and electrical conductivity of three solutions. The concentrations of the solutions are the same.

Solution	NaOH	CH ₃ NH ₂	CH ₃ COONa
рН	13.2	11.9	8.98
Electrical conductivity	good	poor	good

Compare and contrast the pH and electrical conductivity of these three solutions.		
Include appropriate equations in your answer.		
pH:		
1		
Electrical conductivity:		

QUESTION TWO

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Sufficient calcium carbonate, $CaCO_3(s)$, is dissolved in water to make a saturated solution.

(i)	Write the equation for the equilibrium occurring in a saturated solution of CaCO ₃ .
(ii)	Write the expression for $K_s(\text{CaCO}_3)$.
(iii)	Calculate the solubility product of $CaCO_3$, $K_s(CaCO_3)$.
	The solubility of $CaCO_3$ is 5.74×10^{-5} mol L ⁻¹ .
	ne marine animals use calcium carbonate to form their shells. Increased acidification of th
	lain why the solubility of CaCO ₃ is higher in an acidic solution.
	an equation to support your explanation.

0.00421 mol L ⁻¹ lead(II) nitrate, Pb(NO ₃) ₂ , solution.	
$K_{\rm s}({\rm Pb(OH)}_2) = 8.00 \times 10^{-17} \text{ at } 25^{\circ}{\rm C}$	

QUESTION THREE

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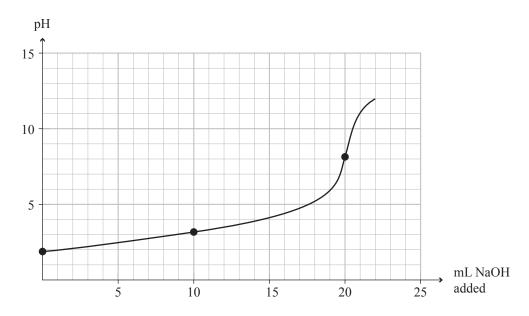
20.0~mL of 0.258~mol L $^{-1}$ hydrofluoric acid, HF, solution is titrated with a sodium hydroxide, NaOH, solution.

The equation for the reaction is:

$$HF + NaOH \rightarrow NaF + H_2O$$

 $pK_a(HF) = 3.17$

The titration curve is given below:



- (a) (i) Identify the species in solution at the equivalence point.
 - (ii) Explain why the pH at the equivalence point is greater than 7.

Include an equation in your answer.

Calculate the j	oH of this solution,	and evaluate i	ts ability to fur	ection as a buf	fer.
	calculation, the pH een added.	of the solution	n after 24.0 mL	of 0.258 mol	L ⁻¹ NaO
		of the solution	n after 24.0 mL	of 0.258 mol	L ⁻¹ NaO
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Determine by solution has b		of the solution	n after 24.0 mL	of 0.258 mol	L-1 NaO
		of the solution	n after 24.0 mL	of 0.258 mol	L ⁻¹ NaO
		of the solution	n after 24.0 mL	of 0.258 mol	L ⁻¹ NaO
		of the solution	n after 24.0 mL	of 0.258 mol	L-1 NaO
		of the solution	n after 24.0 mL	of 0.258 mol	L-1 NaO
		of the solution	n after 24.0 mL	of 0.258 mol	L-1 NaO
		of the solution	n after 24.0 mL	of 0.258 mol	L-1 NaO
		of the solution	n after 24.0 mL	of 0.258 mol	L-1 NaO

Question Three continues on the following page.

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(b)	In a second titration, a $0.258 \text{ mol } L^{-1}$ ethanoic acid, CH_3COOH , solution was titrated with the NaOH solution.	ASSESSOR'S USE ONLY
	Contrast the expected pH at the equivalence point with the HF titration.	
	$pK_a(CH_3COOH) = 4.76$	
	No calculations are necessary.	
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		Extra paper if required.	
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