Name:	Teacher:

Level 3 Chemistry

91392 Demonstrate understanding of equilibrium principles in aqueous systems

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

You should attempt ALL the questions in this booklet.

A periodic table is provided in the Resource Sheet.

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 2–9 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

ASSESSOR'S USE ONLY

QUESTION ONE

8.00×10^{-3} g of calcium fluoride, CaF_2, will dissolve in 500 mL of water.

$M(CaF_2) = 78.0$ g mol^{-1}.

(a) Write the solubility product expression, K_s, for calcium fluoride.

(b) (i) Calculate the solubility of calcium fluoride in mol L^{-1}, at this temperature.

(ii) Calculate the K_s of calcium fluoride.

(c) Explain how the solubility of calcium fluoride, CaF_2, will change if added to 500 mL of a 0.200 mol L^{-1} sodium fluoride solution instead of 500 mL of water.
Support your answer with balanced equations.
No calculations are necessary.

(d) Determine whether a precipitate will form when 20.0 mL of 0.00200 mol L^{-1} potassium chromate, K_2CrO_4 are mixed with 60.0 mL of 1.25 x 10^{-4} mol L^{-1} lead nitrate, $Pb(NO_3)_2$. $K_s(PbCrO_4)$ = 2.8 x 10^{-13} at 25°C.

Question Two

(a) Methyl ammonium bromide, CH_3NH_3Br dissolves in water to form a weakly acidic solution. $K_a(CH_3NH_3^+)$ is 2.28×10^{-11}.

Write an equation for when methyl ammonium bromide dissolves in water AND the reaction that then occurs in the aqueous solution.

(b) Calculate the pH of 0.350 mol L^{-1} CH_3NH_3Br solution.

(c) The table shows the pH and electrical conductivity of three solutions. Their concentrations are all 0.150 mol L^{-1}.

Solution	$C_6H_5NH_2$	NaOH	NH_4Cl
pH	8.91	13.2	5.06
Electrical conductivity	poor	good	good

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

pH:

Electrical conductivity:

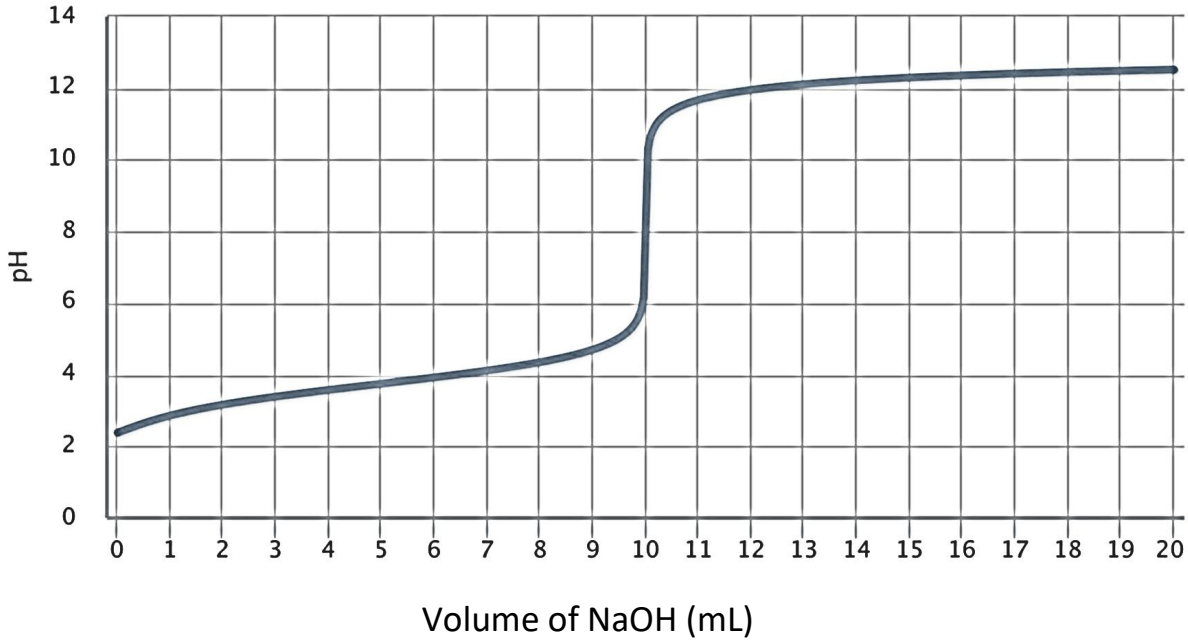
Question Three

Methanoic acid, HCOOH, is a weak acid. $pK_a(HCOOH) = 3.75$

(a) (i) List all the species present in a solution of HCOOH, in order of decreasing concentration. Do not include water.

(ii) Show that the pH of a 0.100 mol L^{-1} methanoic acid solution is 2.38.

(b) (i) Here is the titration curve for the addition of 20.0 mL of 0.100 mol L^{-1} sodium hydroxide solution to 10.0 mL of 0.100 mol L^{-1} methanoic acid solution. Clearly label the buffer zone and equivalence point.



(ii) Identify the indicator that would be most suitable for this titration and explain your choice.

Indicator	Bromocresol green	Phenolphthalein	Alizarin yellow R
pK_a	4.7	9.4	11.2

(c) A buffer solution is formed when sodium hydroxide solution is added to methanoic acid. Using equations involving methanoate ions, describe how a solution containing methanoic acid and sodium methanoate acts as a buffer.

(d) (i) 2.45 g of sodium hydroxide was added to 400 mL of 0.350 mol L^{-1} methanoic acid. Calculate the pH of the buffer. M(NaOH) = 40.0 g mol^{-1}.

(ii) Evaluate the ability of this solution, in (d)(i) to function as a buffer.

Extra paper if required.

Write the question number(s) if applicable