Level 3 Chemistry: practice paper 2026

AS 91392 Demonstrate understanding of equilibrium principles in aqueous systems · Vertex Academy practice paper, not an NZQA paper

Attempt ALL the questions. Show ALL working. Write your answers on lined paper, or in the space under each question.

QUESTION ONE

(a) Magnesium hydroxide, $Mg(OH)_2$, is the active ingredient in some antacids. $K_s(Mg(OH)_2) = 5.61 \times 10^{-12}$ at 25 °C.
Write the equation for the equilibrium in a saturated solution of $Mg(OH)_2$, and the expression for K_s.

(b) Calculate the solubility, s, of $Mg(OH)_2$ in pure water at 25 °C, in mol L^{-1}.

(c) Calculate the solubility of $Mg(OH)_2$ in 0.0500 mol L^{-1} sodium hydroxide solution, and explain why it is different from its solubility in water.

(d) 20.0 mL of 0.00100 mol L^{-1} $MgCl_2$ solution is mixed with 30.0 mL of 0.000200 mol L^{-1} NaOH solution.
Show whether a precipitate of $Mg(OH)_2$ forms. Then discuss why solid $Mg(OH)_2$ dissolves when hydrochloric acid is added.

QUESTION TWO

(a) Ethanoic acid, CH_3COOH, is a weak acid: Ka = 1.74×10^{-5}.
Write the expression for Ka, and list the species present in a 0.100 mol L^{-1} solution of ethanoic acid (other than water) in order of decreasing concentration.

(b) Calculate the pH of 0.100 mol L^{-1} ethanoic acid.

(c) Calculate the pH of 0.0500 mol L^{-1} sodium ethanoate, CH_3COONa, solution, and explain why the solution is basic. Kw = 1.00×10^{-14}.

(d) A buffer solution contains 0.100 mol L^{-1} ethanoic acid and 0.0800 mol L^{-1} sodium ethanoate. Calculate the pH of the buffer, and discuss how it keeps its pH nearly constant when a small amount of acid or of base is added.

QUESTION THREE

(a) 20.0 mL of 0.120 mol L^{-1} ammonia, NH_3, is titrated with 0.100 mol L^{-1} hydrochloric acid. pKa(NH_4^+) = 9.24.
Calculate the volume of HCl needed to reach the equivalence point, and state the pH when half that volume has been added.

(b) Choose the best indicator from the table for this titration, and give a reason.

Indicator	pH range of colour change
phenolphthalein	8.3 to 10.0
bromothymol blue	6.0 to 7.6
methyl red	4.4 to 6.2

(c) Calculate the pH at the equivalence point, and explain why it is below 7.

(d) Calculate the pH after (i) 6.00 mL and (ii) 30.0 mL of HCl have been added. Then discuss how the main species in the flask change through the titration.

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