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A' Level Chemistry

Year 2

Unit 14: Acids & Bases

Summer Examination Revision Pack

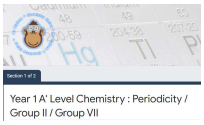
The questions in this pack should be attempted **AFTER** completing all other revision.

Grade Accelerator
Recall Definitions
Drawing Diagrams
Using Equations
Drawing Graphs

Quizlet

Quizlet Classes
Flashcard Based
Games
Tests & Quizzes
Keyword Spell Checker

Condensed Notes
Keywords & Definitions
Key Concepts
Application
Key Skills



Online Forms
Take Time to Answer
Use Paper & Calculator
Work It Out
Review Missed Marks

Use the 3 Wave Process when completing these revision packs.

1. Complete the questions without assistance
(Can't answer a question? Leave it and move on)
2. Use your notes to fill any gaps after step 1
3. Use the mark scheme to fill in any remaining gaps.

1. Having gaps after step 1 is normal, that's why we are doing revision!
2. If your notes don't help during step 2, they are not good enough!
(Change your note taking method and try to understand the problem)
3. If you don't understand why the mark scheme answer is correct, **see Andy.**

If you struggle with the questions in the pack, **STOP!** and complete some more revision.

If you come to a complete dead-end, **STOP!** and speak to **Andy** asap.

0 2 This question is about acidic solutions.

0 2 . 1 The acid dissociation constant, K_a, for ethanoic acid is given by the expression

$$K_a = \frac{[CH_3COO^-][H^+]}{[CH_3COOH]}$$

The value of K_a for ethanoic acid is 1.74×10^{-5} mol dm^{-3} at 25 °C

A buffer solution with a pH of 3.87 was prepared using ethanoic acid and sodium ethanoate. In the buffer solution, the concentration of ethanoate ions was 0.136 mol dm^{-3}

Calculate the concentration of the ethanoic acid in the buffer solution.
Give your answer to three significant figures.

[3 marks]

Concentration of acid _____ mol dm^{-3}

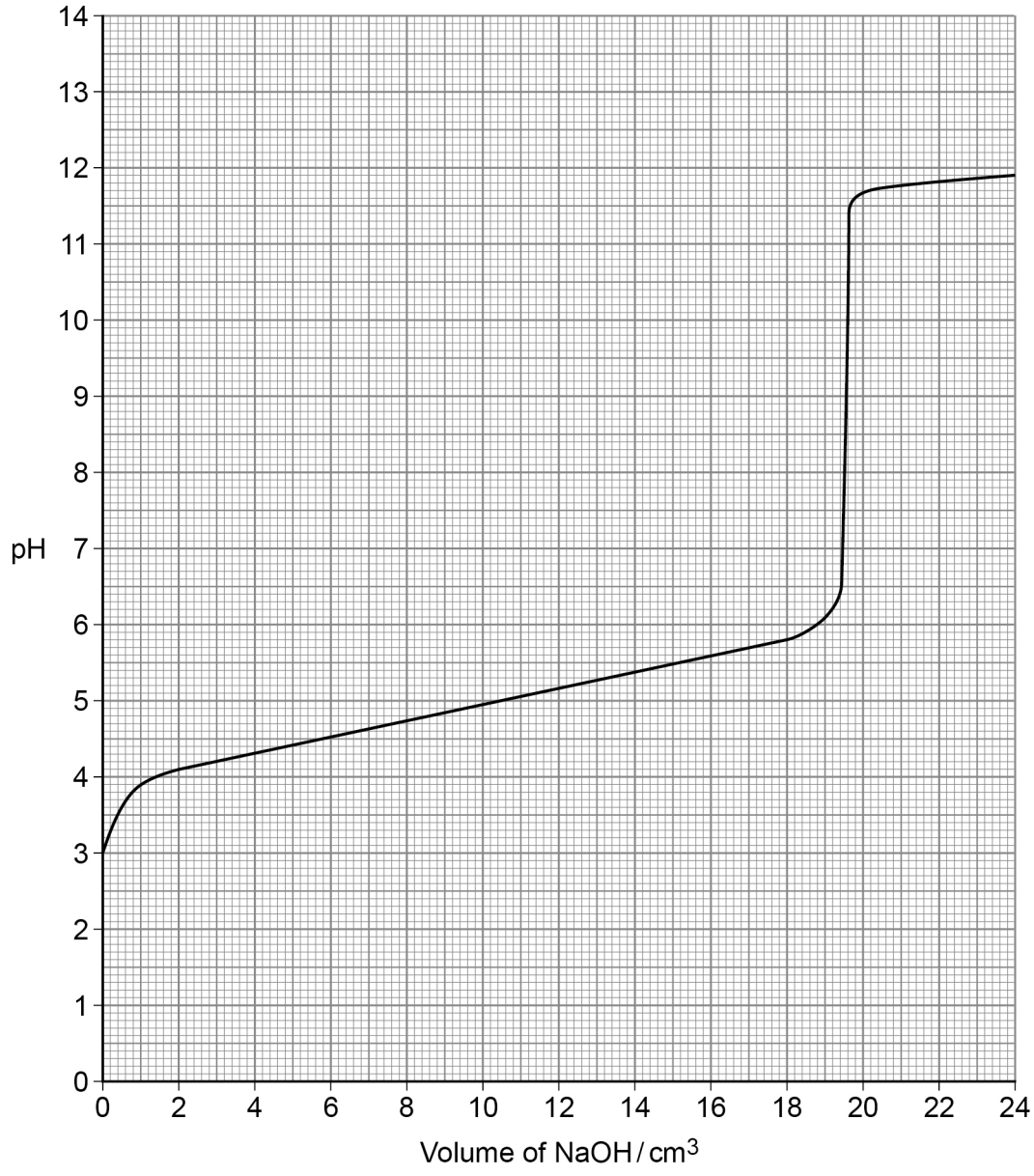
Question	Answers	Mark	Additional Comments/Guidance
02.1	$[H^+] = (10^{-3.87} =) 1.3489 \times 10^{-4}$	1	Allow 1.35×10^{-4}. If M1 wrong can only score M2.
	$[CH_3COOH] = \frac{[H^+][CH_3COO^-]}{[Ka]} = (\frac{[1.3489 \times 10^{-4}][0.136]}{[1.74 \times 10^{-5}]} = 1.05436)$	1	Mark is for correctly rearranged equation.
	1.05– 1.06 (mol dm^{-3})	1	3 sf or more

Do not write outside the box

0 9 . 2 Sodium hydroxide solution was added gradually from a burette to 25 cm^3 of 0.080 mol dm^{-3} propanoic acid at 25 °C
The pH was measured and recorded at regular intervals.

The results are shown in **Figure 4**.

Figure 4



Do not write outside the box

Use **Figure 4** to determine the value of K_a for propanoic acid at 25 °C

Show your working.

[3 marks]

K_a _____ mol dm^{-3}

0 9 . 3 Suggest which indicator is the most appropriate for the reaction in Question **09.2**?
Tick (✓) **one** box.

[1 mark]

Indicator	**pH range**	**Tick (✓) one box**
methyl orange	3.1 – 4.4	
bromothymol blue	6.0 – 7.6	
cresolphthalein	8.2 – 9.8	
indigo carmine	11.6 – 13.0	

Question 9 continues on the next page

Question	Answers	Additional Comments/Guidelines	Mark
09.2	View with Figure X (ie graph) as they may show working there. M1: Determines volume at half equivalence (= $\frac{19.5}{2}$cm^3) = 9.75 (cm^3) M2: pH = 4.80 to 4.95 M3: K_a (= 10^{-pH}) = $10^{-4.9}$ = 1.26 x 10^{-5} Alternative method M1: pH of pure acid = 3 M2: K_a = $(10^{-3})^2$ / 0.080 M3: = 1.25 x 10^{-5}	Ignore calculations of mols of salt or acid M1: Allow reading on graph to be from 19.4 to 19.7 giving M1 = 9.7 to 9.85 M2: Reads off pH at half equivalence M3: Allow 1.12 x 10^{-5} to 1.58 x 10^{-5} M3: Allow 2sf or more Alternative M1 if calculation incorrect: Allow pH = pK_a or [H^+] = K_a at <u>half equivalence</u>	1 1 1
09.3	cresolphthalein		1

Do not write outside the box

0 4 Propanoic acid (C_2H_5COOH) is a weak acid.

The acid dissociation constant (K_a) for propanoic acid is 1.35×10^{-5} mol dm^{-3} at 25 °C

0 4 . 1 State the meaning of the term weak acid.

[1 mark]

0 4 . 2 Give an expression for the acid dissociation constant for propanoic acid.

[1 mark]

K_a

0 4 . 3 A student dilutes 25.0 cm^3 of 0.500 mol dm^{-3} propanoic acid by adding water until the total volume is 100.0 cm^3

Calculate the pH of this diluted solution of propanoic acid.

Give your answer to 2 decimal places.

[4 marks]

pH _____

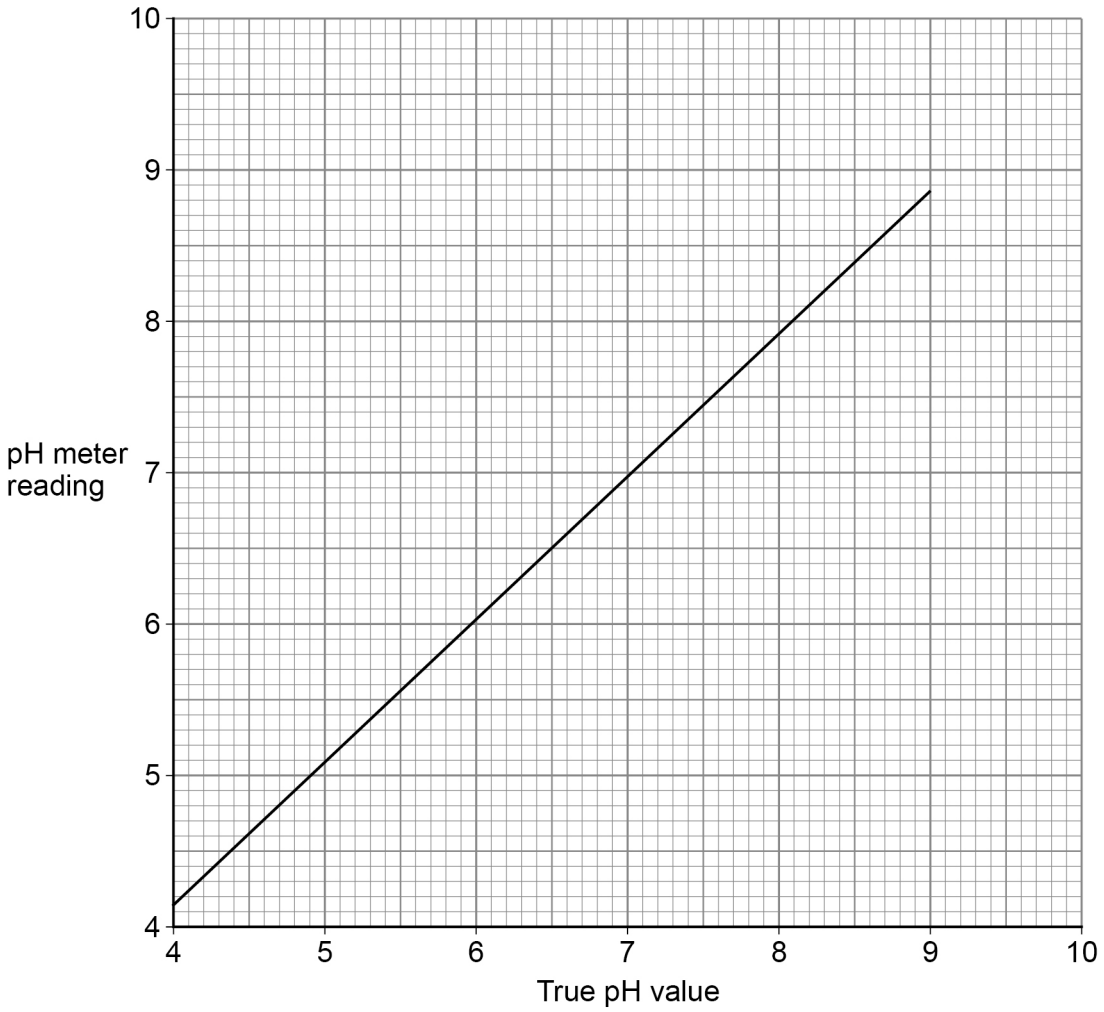
Question	Answers	Additional comments/Guidelines	Mark
04.1	(Acid) partially or slightly ionises/dissociates (in water to form H^+ ions)	Allow – does not fully ionise/dissociate	1
04.2	$(K_a) = \frac{[H^+]\,[C_2H_5COO^-]}{[C_2H_5COOH]}$	Allow $[H_3O^+]$ for $[H^+]$ Do not allow ( )	1
04.3	M1 $[C_2H_5COOH] = \underline{0.125}$ (mol dm^{-3})	Allow consequential marking from wrong M1 If $[C_2H_5COOH] = 0.0125$ (mol dm^{-3}) lose M1, allow M2, M3 = 4.108×10^{-4} and M4 = 3.39	1
	M2 $[H^+] = \sqrt{Ka \times [C_2H_5COOH]}$ OR $[H^+] = \sqrt{1.35 \times 10^{-5} \times 0.125}$		1
	M3 $[H^+] = 1.30 \times 10^{-3}$ (mol dm^{-3})		1
	M4 $pH = -\log_{10}(1.30 \times 10^{-3}) = 2.89$	Allow M4 = $-\log_{10}$ M3 Answer must be to 2 decimal places	1

Do not write outside the box

A pH meter is calibrated using a calibration graph.
To create the calibration, the pH meter is used to measure the pH of separate solutions, each with a known, accurate pH.

Figure 3 shows the calibration graph.

Figure 3



0 6 . 4 Use **Figure 3** to give the true pH value when the pH meter reading is 5.6

[1 mark]

0 6 . 5 Suggest why the pH probe is washed with distilled water between each of the calibration measurements.

[1 mark]

Do not write outside the box

0 6 . 6 The calibrated pH meter is used to monitor the pH during a titration of hydrochloric acid with sodium hydroxide.

Explain why the volume of sodium hydroxide solution added between each pH measurement is smaller as the end point of the titration is approached.

[1 mark]

Figure 4 shows the pH curve for a titration of hydrochloric acid with sodium hydroxide solution.

Figure 4

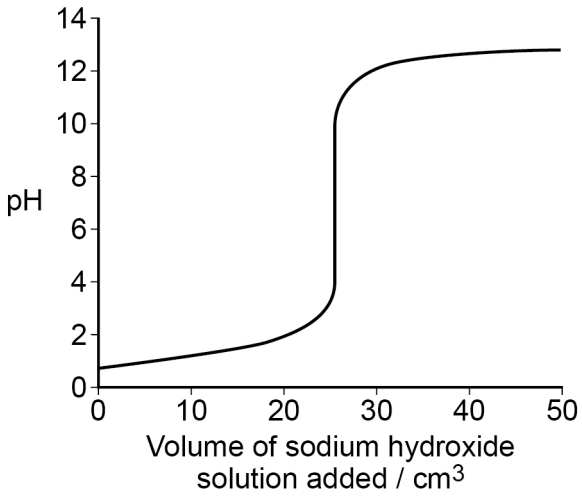


Table 6 shows data about some indicators.

Table 6

Indicator	pH range	Colour at low pH	Colour at high pH
Bromocresol green	3.8 – 5.4	yellow	blue
Phenol red	6.8 – 8.4	yellow	red
Thymolphthalein	9.3 – 10.5	colourless	blue

The student plans to do the titration again using one of the indicators in **Table 6** to determine the end point.

0 6 . 7 State why all three of the indicators in **Table 6** are suitable for this titration.

[1 mark]

Do not write outside the box

0 6 . 8 36.25 cm^3 of 0.200 mol dm^{-3} sodium hydroxide solution are added to 25.00 cm^3 of 0.150 mol dm^{-3} hydrochloric acid.

Calculate the pH of the final solution at 25 °C

$K_w = 1.00 \times 10^{-14}$ $mol^2\ dm^{-6}$ at 25 °C

[5 marks]

pH _____

16

Question	Answers	Additional comments/Guidelines	Mark
06.4	5.55	Allow 5.5 to 5.6	1

Question	Answers	Additional comments/Guidelines	Mark
06.5	Different solutions must not contaminate each other or To wash off any residual solution/substance (which could interfere with the reading)	pH of previous solution doesn't contaminate new solution Ignore to make neutral/neutralise Ignore so as not to affect concentrations	1

Question	Answers	Additional comments/Guidelines	Mark
06.6	To avoid missing the end point Or (Very little pH change per cm^3 added at start) large change in pH (near end point)		1

Question	Answers	Additional comments/Guidelines	Mark
06.7	All have a colour change/pH range within the steep/vertical part of the titration curve	Colour change/pH range between pH 3 and 11	1

Question	Answers	Additional comments/Guidelines	Mark
06.8	M1 Amount of OH^- = $36.25 \times 0.200 \div 1000 = 7.25 \times 10^{-3}$ mol **and** Amount of H^+ = $25.0 \times 0.150 \div 1000 = 3.75 \times 10^{-3}$ mol		1
	M2 Amount of excess OH^- = $7.25 \times 10^{-3} - 3.75 \times 10^{-3}$ = 3.50×10^{-3} mol		1
	M3 $[OH^-] = (3.50 \times 10^{-3}) \div (61.25 \times 10^{-3})$ (= 5.71×10^{-2} mol)	M3 $[OH^-]$ = (M2) ÷ (61.25×10^{-3})	1
	M4 $[H^+] = \underline{1.00 \times 10^{-14}} \div 5.71 \times 10^{-2} = 1.75 \times 10^{-13}$	M4 $[H^+] = 1.00 \times 10^{-14} \div$ M3	1
	M5 pH = 12.76	M5 Allow pH = 12.8 M5 pH = $-\log_{10}$(M4) Alternative Method M4 p OH = 1.24 M5 pH = 14 – 1.24 = 12.76	1