

OCR A-Level Chemistry A

Acids, bases and buffers

Questions only

The newest questions, about an hour. All 19 are in the exam generator.

Questions

9

Total marks

39

Time allowed

53 min

Name

Class or teacher

Date

Instructions

- Answer all questions in the spaces provided.
- Use black ink. Show your working for every calculation.
- You may use a scientific calculator and the OCR Data Sheet.
- Print the separate mark scheme when you are ready to mark your answers.

For marking

Q	Source	Marks	Score
1	2019 P1 Q12	1	
2	2022 P1 Q11	1	
3	2022 P1 Q12	1	
4	2024 P1 Q12	1	
5	2024 P1 Q19	11	
6	2024 P3 Q1	10	
7	2025 P1 Q13	1	
8	2025 P1 Q19	12	
9	2020 P1 Q11	1	

Total _____ / 39 Percentage _____ %

Questions from OCR past papers, 2019–2025, reproduced for revision. Practise these topics online, with instant marking:

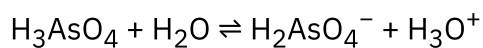
whiteboardchemistry.com/revision/exam-questions/ocr-a-level-chemistry/?topics=acids-bases-and-buffers&len=0

Questions

Acids, bases and buffers · 9 questions · 39 marks · time allowed 53 min

Q1 · June 2019 · Paper 1 (Periodic table, elements and physical chemistry) · Q12 · [1 mark]

The equation shows the dissociation of the acid H_3AsO_4 in water.



Which pair is a conjugate acid–base pair?

Tick (✓) one box.

- ☐ **A** H_3AsO_4 and H_2O
- ☐ **B** H_2AsO_4^- and H_3O^+
- ☐ **C** H_3AsO_4 and H_3O^+
- ☐ **D** H_3O^+ and H_2O

Q2 · June 2022 · Paper 1 (Periodic table, elements and physical chemistry) · Q11 · [1 mark]

The equilibrium equation for an indicator, HA, is shown below.

Equation:	HA(aq)	$\rightleftharpoons$	$\text{A}^-(\text{aq})$	+	$\text{H}^+(\text{aq})$
Colour:	Blue		Yellow		

The indicator is added to a solution. The indicator turns a yellow colour.

An excess of aqueous sodium hydroxide is then added.

Which statement describes how the colour of this solution would be expected to change?

Tick (✓) one box.

- ☐ **A** Colour changes from yellow to blue.
- ☐ **B** Colour changes from yellow to green.
- ☐ **C** Colour changes from yellow to green and then to blue.
- ☐ **D** Colour stays yellow.

Q3 · June 2022 · Paper 1 (Periodic table, elements and physical chemistry) · Q12 · [1 mark]

Ammonia and water react to set up an acid–base equilibrium.

What are the Brønsted–Lowry acids in the equilibrium mixture?

Tick (✓) one box.

- ☐ **A** H_2O and OH^-
- ☐ **B** OH^- and NH_3
- ☐ **C** NH_4^+ and H_2O
- ☐ **D** NH_4^+ and NH_3

Q4 · June 2024 · Paper 1 (Periodic table, elements and physical chemistry) · Q12 · [1 mark]

Which solution can be added to $\text{CH}_3\text{COOH}(\text{aq})$ to make a buffer solution?

Tick (✓) one box.

- ☐ **A** $\text{CH}_3\text{COONa}(\text{aq})$
- ☐ **B** $\text{HCOOH}(\text{aq})$
- ☐ **C** $\text{HCl}(\text{aq})$
- ☐ **D** $\text{NaCl}(\text{aq})$

Q5 · June 2024 · Paper 1 (Periodic table, elements and physical chemistry) · Q19 · [11 marks]

This question is about acids and bases.

Chloroethanoic acid, ClCH_2COOH , is a weak monobasic acid.

19(a)(i) Write the expression for the acid dissociation constant, K_a , of ClCH_2COOH .

[1 mark]

19(a)(ii) The expression for the acid dissociation constant, K_a , of ClCH_2COOH can be simplified to:

$$K_a = [\text{H}^+]^2 / [\text{ClCH}_2\text{COOH}] \text{ Expression 19.1}$$

State one approximation that allows the expression from (a)(i) to be simplified to Expression 19.1.

[1 mark]

19(a)(iii) A student carries out an experiment to determine the $\text{p}K_a$ value of a solution of ClCH_2COOH .

- The concentration of ClCH_2COOH is $0.090 \text{ mol dm}^{-3}$.
- The pH of ClCH_2COOH is 1.95.

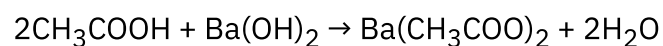
Use Expression 19.1 to calculate the $\text{p}K_a$ value of ClCH_2COOH .

Give your answer to **2** decimal places.

$\text{p}K_a =$

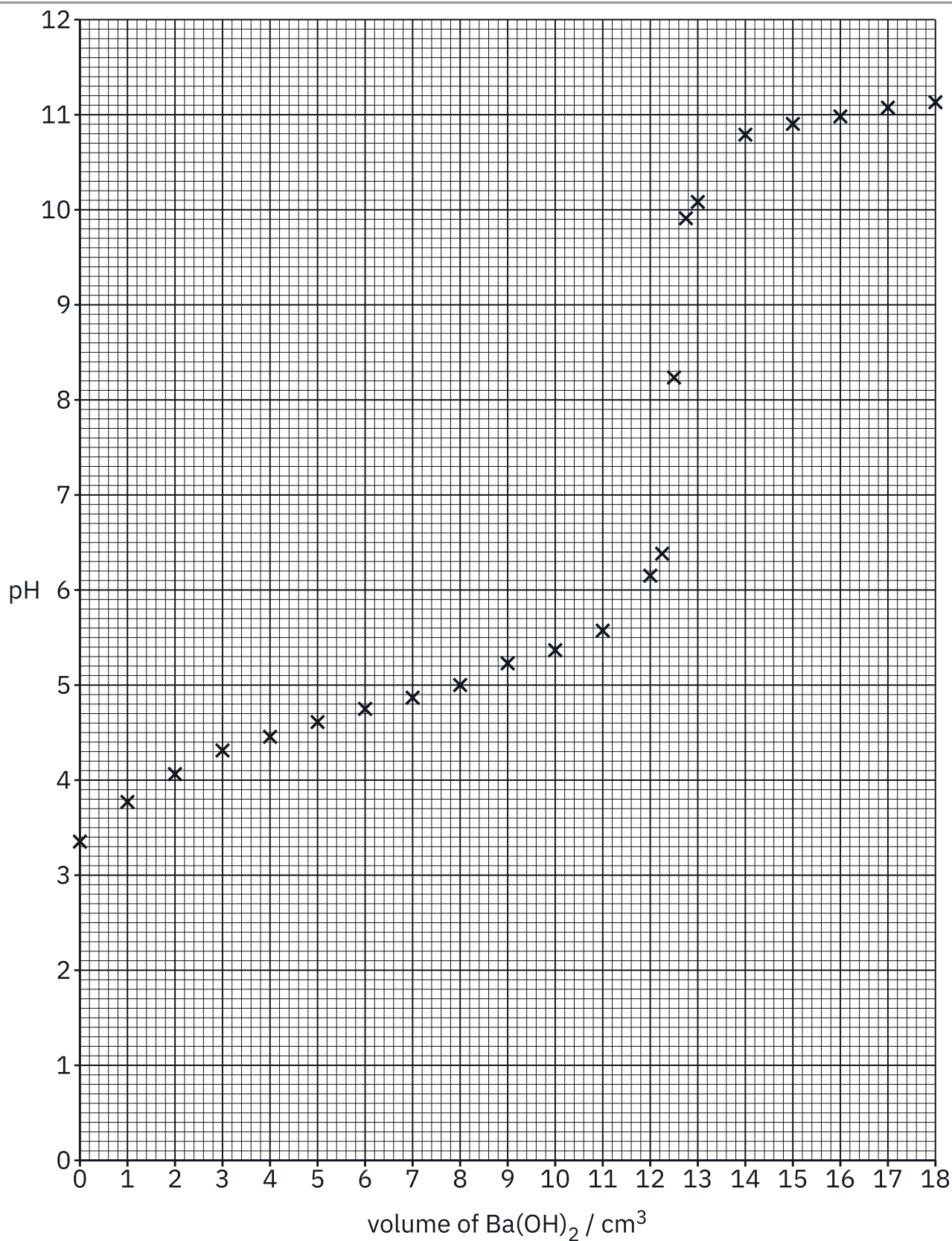
[3 marks]

A student titrates a 10.0 cm^3 sample of ethanoic acid, CH_3COOH , against an aqueous solution of $0.0560 \text{ mol dm}^{-3} \text{ Ba(OH)}_2$.



The student used a pH meter to measure the pH of the mixture after every addition of Ba(OH)_2 throughout the titration.

The student's results are shown below.



19(b)(i) Draw a best-fit curve on the graph and calculate the concentration of the CH_3COOH solution.

CH_3COOH concentration = mol dm^{-3}

[5 marks]

Draw your answer on the figure above.

19(b)(ii) The end point of the titration can also be found by observing the colour change of an indicator.

The pH ranges of some indicators are shown in the table.

Indicator	pH range
Malachite green	0.2 – 1.8
Bromophenol blue	2.8 – 4.6
Phenol red	6.8 – 8.4
Phenolphthalein	8.2 – 10.0

Identify the indicator in the table that would be suitable to observe the end point of the titration between CH_3COOH and $\text{Ba}(\text{OH})_2$.

[1 mark]

Q6 · June 2024 · Paper 3 (Unified chemistry) · Q1 · [10 marks]

This question also needs Acids and redox reactions.

This question is about acids, bases and salts.

1(a) What is the pH of 1.00 dm^3 of $0.400 \text{ mol dm}^{-3}$ of $\text{NaOH}(\text{aq})$ at 298 K?

pH =

[2 marks]

1(b) Water is added to 10.0 cm^3 of $0.750 \text{ mol dm}^{-3}$ HCl(aq) to produce 100 cm^3 of diluted HCl(aq) .

What is the pH of the diluted HCl(aq) ?

Give your answer to **2** decimal places.

pH =

[1 mark]

1(c) A solution has concentrations of $0.300 \text{ mol dm}^{-3}$ $\text{CH}_3\text{COOH(aq)}$ and $0.100 \text{ mol dm}^{-3}$ $\text{CH}_3\text{COONa(aq)}$.

K_a for $\text{CH}_3\text{COOH} = 1.75 \times 10^{-5} \text{ mol dm}^{-3}$ at 298 K.

What is the pH of the solution at 298 K?

Give your answer to **2** decimal places.

pH =

[2 marks]

1(d) A student is provided with hydrated copper(II) nitrate, $\text{Cu}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$.

The student needs to prepare a standard solution of $\text{Cu}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$ with a concentration of $0.200 \text{ mol dm}^{-3}$. The student has access to usual laboratory apparatus and equipment.

Describe how the student would prepare 100.0 cm^3 of this solution, giving quantities, apparatus and method.

[5 marks]

Q7 · June 2025 · Paper 1 (Periodic table, elements and physical chemistry) · Q13 · [1 mark]

A mixture of ethanoic acid and ethanol is left to reach equilibrium.

A student determines the amount of ethanoic acid remaining in the equilibrium mixture by titrating the mixture with a solution of sodium hydroxide.

Which row of the table shows a suitable indicator for the titration?

Tick (✓) one box.

- ☐ **A** pH range of the indicator: 1.2 – 2.8
- ☐ **B** pH range of the indicator: 4.8 – 6.0
- ☐ **C** pH range of the indicator: 9.4 – 10.6
- ☐ **D** pH range of the indicator: 12.0 – 13.4

Q8 · June 2025 · Paper 1 (Periodic table, elements and physical chemistry) · Q19 · [12 marks]

This question also needs Acids and redox reactions.

This question is about monobasic acids and buffer solutions.

19(a) Nitric acid, HNO_3 , is a strong monobasic acid.

Calculate the pH of $0.150 \text{ mol dm}^{-3} \text{ HNO}_3$.

Give your answer to **2** decimal places.

pH =

[1 mark]

19(b)(i) Nitrous acid, HNO_2 , is a weak monobasic acid.

Predict whether the pH of $0.150 \text{ mol dm}^{-3} \text{ HNO}_2$ is higher, lower or the same as the pH of $0.150 \text{ mol dm}^{-3}$ nitric acid, HNO_3 .

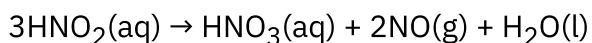
Explain your answer.

[2 marks]

Prediction

Explanation

19(b)(ii) When heated, aqueous HNO_2 disproportionates. The equation is shown below.



- What is meant by **disproportionation**?
- Use oxidation numbers to show that disproportionation has taken place.

[3 marks]

19(c) A student plans to prepare a buffer solution with a pH of 4.85 using propanoic acid, $\text{CH}_3\text{CH}_2\text{COOH}$, and sodium propanoate, $\text{CH}_3\text{CH}_2\text{COONa}$.

K_a for $\text{CH}_3\text{CH}_2\text{COOH} = 1.32 \times 10^{-5} \text{ mol dm}^{-3}$.

The student mixes 125 cm^3 of $0.180 \text{ mol dm}^{-3}$ $\text{CH}_3\text{CH}_2\text{COOH}(\text{aq})$ with a calculated mass of $\text{CH}_3\text{CH}_2\text{COONa}(\text{s})$. The student assumes that the volume of the solution does not change.

- Calculate the mass of $\text{CH}_3\text{CH}_2\text{COONa}$ needed to make 125 cm^3 of a buffer solution with a pH of 4.85.
- Explain why this solution resists changes in pH when a small amount of alkali is added.

[6 marks]

Q9 · November 2020 · Paper 1 (Periodic table, elements and physical chemistry) · Q11 · [1 mark]

This question also needs Amount of substance.

20 cm³ of 0.10 mol dm⁻³ hydrochloric acid is added to 10 cm³ of 0.10 mol dm⁻³ sodium hydroxide.

What is the pH of the resulting mixture?

Tick (✓) one box.

☐ **A** 1.00

☐ **B** 1.18

☐ **C** 1.30

☐ **D** 1.48

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Mark scheme:

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