

OCR A-Level Chemistry A

Amount of substance

Questions only

The newest questions, about an hour. All 60 are in the exam generator.

Questions

9

Total marks

43

Time allowed

58 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	2023 P1 Q19	13	
2	2023 P1 Q21	10	
3	2024 P1 Q3	1	
4	2025 P1 Q2	1	
5	2025 P2 Q2	1	
6	2025 P2 Q3	1	
7	2025 P2 Q5	1	
8	2025 P2 Q6	1	
9	2025 P3 Q2	14	

Total _____ / 43 Percentage _____ %

Questions from OCR past papers, 2023–2025, reproduced for revision. Practise these topics online, with instant marking:

whiteboardchemistry.com/revision/exam-questions/ocr-a-level-chemistry/?topics=amount-of-substance&len=0

Questions

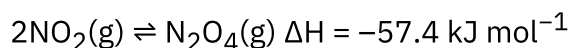
Amount of substance · 9 questions · 43 marks · time allowed 58 min

Q1 · June 2023 · Paper 1 (Periodic table, elements and physical chemistry) · Q19 · [13 marks]

This question also needs Equilibrium constants K_c and K_p .

This question is about oxides of nitrogen.

An investigation is carried out on the equilibrium system shown below.



19(a)(i) A sealed flask containing 6.00 moles of $\text{NO}_2(\text{g})$ is heated to a constant temperature and allowed to reach equilibrium.

The equilibrium mixture contains 5.40 mol of $\text{NO}_2(\text{g})$, and the total pressure is 5.00 atm.

Determine the value of K_p and give your answer to **3** significant figures.

Include an expression for K_p and the units of K_p in your answer.

$K_p =$ units

[5 marks]

19(a)(ii) The sealed flask in (a)(i) is then heated to a higher temperature at an increased pressure. The system is allowed to reach equilibrium again.

Explain why it is difficult to predict how these changes in reaction conditions affect the amount of $\text{N}_2\text{O}_4(\text{g})$ formed at equilibrium.

[3 marks]

19(b) N_2O_4 reacts fully with oxygen to form a different oxide of nitrogen, oxide A, as the only product.

Oxide A is collected and cooled to $75.0\text{ }^\circ\text{C}$ at a pressure of 101 kPa .

Under these conditions, oxide A is a gas that occupies a volume of 74.0 cm^3 and has a mass of 0.280 g .

Calculate the molar mass of oxide A and suggest its molecular formula.

molar mass = g mol^{-1}

molecular formula =

[5 marks]

Q2 · June 2023 · Paper 1 (Periodic table, elements and physical chemistry) · Q21 · [10 marks]

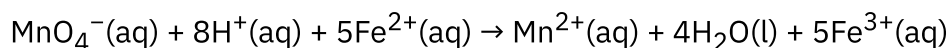
This question also needs Redox and electrode potentials.

Some grass fertilisers contain compounds of iron.

During heavy rain, a fertiliser is washed into a nearby river causing the water to be polluted with a mixture of iron(II) and iron(III) ions.

A student determines the concentration of iron(II) ions in a sample of river water by titration with potassium manganate(VII).

25.0 cm³ portions of river water are acidified with dilute sulfuric acid. Each portion is titrated with 0.00250 mol dm⁻³ potassium manganate(VII) until a colour change is seen.



21(a)(i) State the colour change seen at the end point of the titration.

from to

[1 mark]

21(a)(ii) The student's titration results are shown in the table below.

The trial titre has been omitted.

	1	2	3
Final volume / cm ³	12.65	25.60	38.35
Initial volume / cm ³	0.00	12.65	25.60
Titre volume / cm ³			

Complete the table above and calculate the mean titre that the student should use to determine the concentration of iron(II) ions in the river water.

mean titre = cm³

[2 marks]

21(a)(iii) Determine the concentration, in mol dm^{-3} , of iron(II) ions in the river water.

concentration = mol dm^{-3}

[3 marks]

21(b) The student modifies the experiment in (a) to determine the combined concentration of iron(II) and iron(III) ions in the river water.

The student's method is shown below.

Step 1 Add excess zinc to a 250.0 cm^3 sample of river water and warm gently.

Step 2 Cool the solution and remove excess zinc by filtration.

Step 3 Acidify 25.0 cm^3 portions of the filtrate from Step 2. Then titrate each portion with $0.00250 \text{ mol dm}^{-3}$ potassium manganate(VII) until a colour change is seen.

The table below shows information about three redox systems.

Redox system	Half-equation	$E^\ominus / \text{V}$
1	$\text{Zn}^{2+}(\text{aq}) + 2\text{e}^- \rightleftharpoons \text{Zn}(\text{s})$	-0.76
2	$\text{Fe}^{3+}(\text{aq}) + \text{e}^- \rightleftharpoons \text{Fe}^{2+}(\text{aq})$	+0.77
3	$\text{MnO}_4^-(\text{aq}) + 8\text{H}^+(\text{aq}) + 5\text{e}^- \rightleftharpoons \text{Mn}^{2+}(\text{aq}) + 4\text{H}_2\text{O}(\text{l})$	+1.51

Use the information in the table above to explain the reasons for Step 1 and Step 2.

[4 marks]

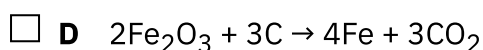
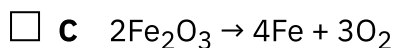
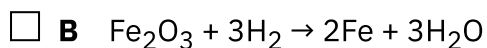
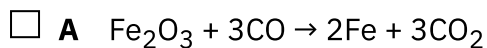
Reason(s) for Step 1

Reason(s) for Step 2

Q3 · June 2024 · Paper 1 (Periodic table, elements and physical chemistry) · Q3 · [1 mark]

Which chemical process is the most sustainable in terms of the atom economy of the iron produced?

Tick (✓) one box.

**Q4 · June 2025 · Paper 1 (Periodic table, elements and physical chemistry) · Q2 · [1 mark]**

11.895 g of hydrated cobalt(II) chloride, $\text{CoCl}_2 \cdot x\text{H}_2\text{O}$, is heated to remove the water of crystallisation.

After heating to constant mass, the mass of the anhydrous salt was 6.495 g.

What is the value of x?

Tick (✓) one box.

☐ **A** 3

☐ **B** 5

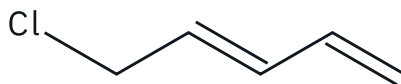
☐ **C** 6

☐ **D** 7

Q5 · June 2025 · Paper 2 (Synthesis and analytical techniques) · Q2 · [1 mark]

0.0200 mol of the compound below reacts with $\text{Br}_2(\text{aq})$ to make a saturated compound.

How many grams of Br_2 are needed for this reaction?



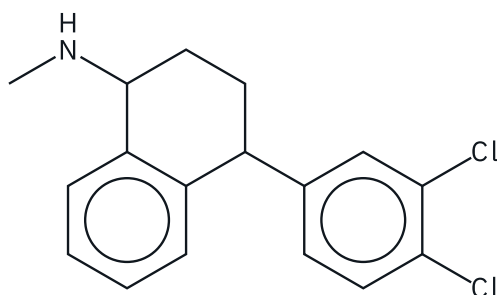
Tick (✓) one box.

- ☐ **A** 3.20
- ☐ **B** 6.39
- ☐ **C** 7.99
- ☐ **D** 12.80

Q6 · June 2025 · Paper 2 (Synthesis and analytical techniques) · Q3 · [1 mark]

The skeletal structure of a medicinal drug is shown below.

How many hydrogen atoms are in its molecular formula?



Tick (✓) one box.

- ☐ **A** 14
- ☐ **B** 15
- ☐ **C** 17
- ☐ **D** 19

Q7 · June 2025 · Paper 2 (Synthesis and analytical techniques) · Q5 · [1 mark]

0.200 mol of $\text{HOOCCH}_2\text{CH}_2\text{COOH}$ is reacted with 0.300 mol NaOH .

How many water molecules are formed?

Tick (✓) one box.

☐ **A** 1.204×10^{23}

☐ **B** 1.806×10^{23}

☐ **C** 2.408×10^{23}

☐ **D** 3.612×10^{23}

Q8 · June 2025 · Paper 2 (Synthesis and analytical techniques) · Q6 · [1 mark]

Propene can be prepared using the reactions shown.

Which reaction has the **lowest** atom economy?

Tick (✓) one box.

☐ **A** $\text{C}_3\text{H}_7\text{Br} \rightarrow \text{C}_3\text{H}_6 + \text{HBr}$

☐ **B** $\text{C}_{12}\text{H}_{26} \rightarrow 2\text{C}_3\text{H}_6 + \text{C}_6\text{H}_{14}$

☐ **C** $\text{C}_8\text{H}_{18} \rightarrow \text{C}_3\text{H}_6 + \text{C}_5\text{H}_{12}$

☐ **D** $\text{C}_3\text{H}_7\text{OH} \rightarrow \text{C}_3\text{H}_6 + \text{H}_2\text{O}$

Q9 · June 2025 · Paper 3 (Unified chemistry) · Q2 · [14 marks]

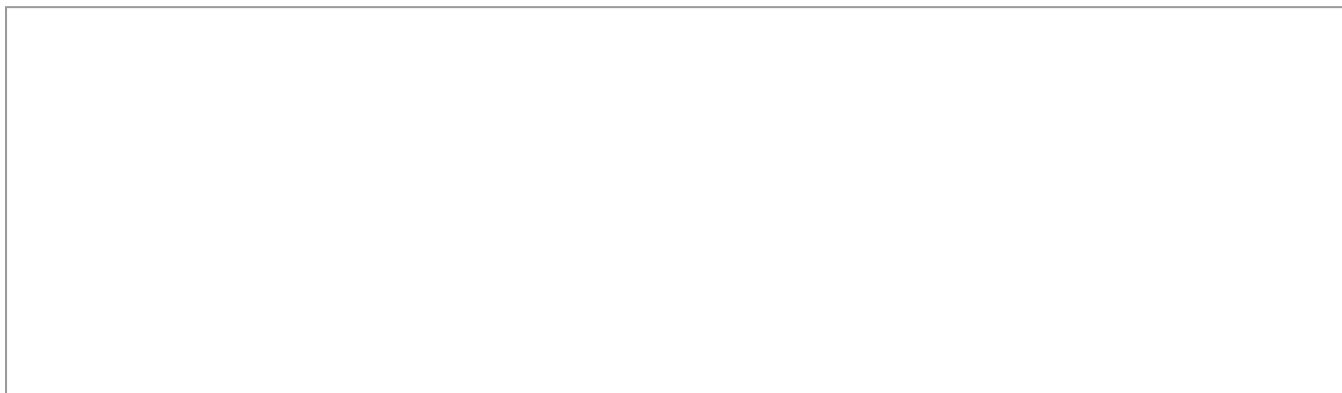
This question also needs Acids, bases and buffers.

This question is about different compounds that each contain O and H atoms covalently bonded together.

The alcohol 2,3-dimethylhexan-1-ol has the molecular formula $\text{C}_8\text{H}_{18}\text{O}$.

2(a)(i) Draw the skeletal formula of 2,3-dimethylhexan-1-ol.

[1 mark]



2(a)(ii) What is the number of H atoms in 8.45 g of 2,3-dimethylhexan-1-ol?

Give your answer to **3** significant figures and in standard form.

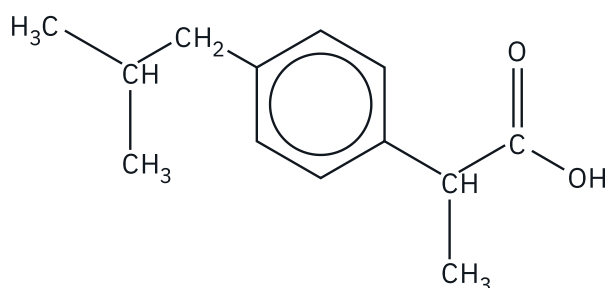
Number of H atoms =

[3 marks]

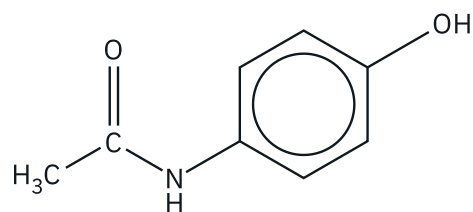
Nuromol tablets are used to relieve pain.

Nuromol tablets contain a mixture of ibuprofen and paracetamol.

The structures of ibuprofen and paracetamol are shown.



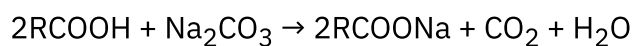
Ibuprofen



Paracetamol

A student carries out an investigation to determine the mass of ibuprofen and the mass of paracetamol in one nuromol tablet.

- Ibuprofen reacts with aqueous sodium carbonate, $\text{Na}_2\text{CO}_3(\text{aq})$, to produce a gas.



- Paracetamol does **not** react with $\text{Na}_2\text{CO}_3(\text{aq})$.

2(b)(i) Why does paracetamol **not** react with $\text{Na}_2\text{CO}_3(\text{aq})$?

[1 mark]

2(b)(ii) The student uses the reaction of nuromol tablets with $\text{Na}_2\text{CO}_3(\text{aq})$ to determine the mass of ibuprofen and the mass of paracetamol in one nuromol tablet.

The student's method is outlined below.

- Weigh **four** nuromol tablets.
- Add the tablets to an excess of aqueous sodium carbonate.
- Collect the gas produced and measure its volume.

Results

Mass of four nuromol tablets = 2.80 g

Volume of gas collected at RTP = 48.0 cm³

Assume that ibuprofen is the only compound in nuromol tablets that reacts with $\text{Na}_2\text{CO}_3(\text{aq})$.

Determine the mass of ibuprofen and the mass of paracetamol, in mg, in **one** nuromol tablet.

Mass of ibuprofen = mg

Mass of paracetamol = mg

[4 marks]

2(c) Barium hydroxide, $\text{Ba}(\text{OH})_2$, is an alkali.

A student is supplied with a solution of $\text{Ba}(\text{OH})_2$ with a concentration of 46.80 g dm^{-3} at 25°C .

The student dilutes 20.0 cm^3 of this solution of $\text{Ba}(\text{OH})_2$ with water and the solution is made up to 100.0 cm^3 at 25°C .

Calculate the pH of the diluted solution of $\text{Ba}(\text{OH})_2$ at 25°C .

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

pH =

[5 marks]

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Mark scheme:

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