

OCR A-Level Chemistry A

Transition elements

Questions only

The newest questions, about an hour. All 21 are in the exam generator.

Questions

9

Total marks

44

Time allowed

59 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 Q14	1	
2	2022 P1 Q15	1	
3	2023 P1 Q14	1	
4	2024 P1 Q13	1	
5	2025 P1 Q15	1	
6	2025 P1 Q21	17	
7	2025 P3 Q4	15	
8	2020 P1 Q15	1	
9	2020 P3 Q2	6	

Total _____ / 44 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=transition-elements&len=0

Questions

Transition elements · 9 questions · 44 marks · time allowed 59 min

Q1 · June 2019 · Paper 1 (Periodic table, elements and physical chemistry) · Q14 · [1 mark]

This question also needs Electrons, bonding and structure.

Which property/properties is/are correct for a transition element?

- 1 The element has atoms with a partially filled d sub-shell.
- 2 The existence of more than one oxidation state in its compounds.
- 3 The formation of coloured ions.

Tick (✓) one box.

- ☐ **A** 1, 2 and 3
- ☐ **B** Only 1 and 2
- ☐ **C** Only 2 and 3
- ☐ **D** Only 1
-

Q2 · June 2022 · Paper 1 (Periodic table, elements and physical chemistry) · Q15 · [1 mark]

Which ion(s) contain(s) one or more unpaired electrons?

- 1 Mn^{3+}
- 2 V^{3+}
- 3 Cu^{+}

Tick (✓) one box.

- ☐ **A** 1, 2 and 3
- ☐ **B** Only 1 and 2
- ☐ **C** Only 2 and 3
- ☐ **D** Only 1

Q3 · June 2023 · Paper 1 (Periodic table, elements and physical chemistry) · Q14 · [1 mark]

Which statement(s) is/are correct for the anti-cancer complex $\text{Pt}(\text{NH}_3)_2\text{Cl}_2$?

- 1 It has bond angles of 90° .
- 2 The oxidation number of Pt is +4.
- 3 It forms both optical and cis-trans isomers.

Tick (✓) one box.

- ☐ **A** 1, 2 and 3
- ☐ **B** Only 1 and 2
- ☐ **C** Only 2 and 3
- ☐ **D** Only 1

Q4 · June 2024 · Paper 1 (Periodic table, elements and physical chemistry) · Q13 · [1 mark]

A student analyses a solution of a salt.

The results are shown below.

Test	Observation
Reaction with $\text{NaOH}(\text{aq})$	Green precipitate
Reaction with $\text{Ba}(\text{NO}_3)_2(\text{aq})$	White precipitate

What is the formula of the salt?

Tick (✓) one box.

- ☐ **A** CuCl_2
- ☐ **B** CuSO_4
- ☐ **C** FeCl_2
- ☐ **D** FeSO_4

Q5 · June 2025 · Paper 1 (Periodic table, elements and physical chemistry) · Q15 · [1 mark]

Chromium forms the complex ions $[\text{Cr}(\text{NH}_3)_6]^{3+}$ and $[\text{Cr}(\text{OH})_6]^{3-}$.

Which statement(s) about the complexes is / are correct?

1 Chromium is in the same oxidation state in each complex ion.

2 The complex ions are different colours.

3 The complex ions have different coordination numbers.

Tick (✓) one box.

☐ **A** 1, 2 and 3

☐ **B** Only 1 and 2

☐ **C** Only 2 and 3

☐ **D** Only 1

Q6 · June 2025 · Paper 1 (Periodic table, elements and physical chemistry) · Q21 · [17 marks]

This question also needs Amount of substance.

This question is about reactions of compounds of iron and copper.

21(a)(i) Complete the electron configuration of an Fe atom: $1s^2$

a Cu^{2+} ion: $1s^2$

[2 marks]

21(a)(ii) Solutions of iron(II) sulfate, FeSO_4 , and copper(II) sulfate, CuSO_4 , can be distinguished by adding aqueous sodium hydroxide.

Describe what would be observed when NaOH(aq) is added to each solution.

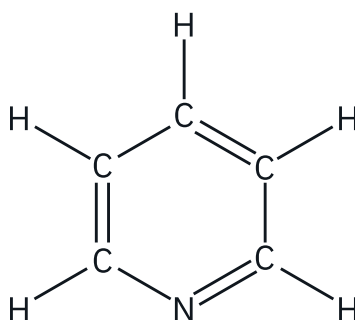
[2 marks]

Observation with $\text{FeSO}_4(\text{aq})$

Observation with $\text{CuSO}_4(\text{aq})$

The cyclic organic compound pyridine, $\text{C}_5\text{H}_5\text{N}$, can act as a monodentate ligand.

The structure of pyridine is shown below.



21(b)(i) What is meant by a **monodentate ligand**?

[1 mark]

21(b)(ii) An iron(II) complex contains two different ligands: $\text{C}_5\text{H}_5\text{N}$, and Cl^- .

The complex has a molar mass of 442.8 g mol^{-1} and the following percentage composition by mass:

Fe, 12.6%; C, 54.3%; H, 4.5%; N, 12.6%; Cl, 16.0%

Determine the empirical formula of the iron(II) complex.

Deduce the number of $\text{C}_5\text{H}_5\text{N}$ ligands in the complex and the coordination number of the iron(II) ion.

[4 marks]

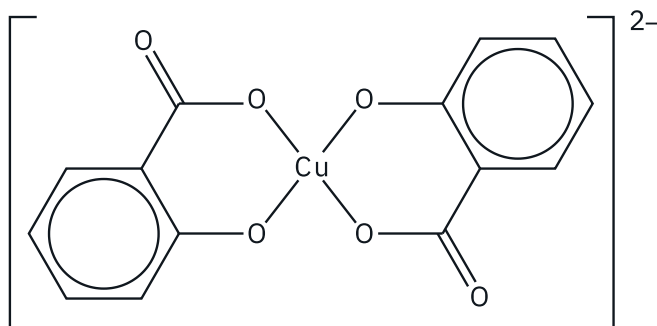
Empirical formula of iron(II) complex

Number of $\text{C}_5\text{H}_5\text{N}$ ligands

Coordination number of iron(II) ion

21(c) Aqueous copper(II) sulfate reacts with salicylic acid to form a complex ion which has two stereoisomers.

One isomer of the complex ion is shown:



Draw the other stereoisomer of the complex.

Identify the type of stereoisomerism shown by the complexes.

Type of stereoisomerism

[2 marks]

Mixture A is a mixture of copper(II) sulfate crystals, $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ and iron(II) sulfate crystals, $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$.

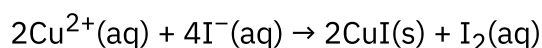
A student carries out a titration to determine the percentage by mass of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ in Mixture A.

The student uses the following method.

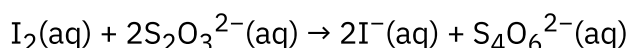
Step 1 Dissolve 9.51 g of Mixture A in water and make up the solution to 250.0 cm^3 in a volumetric flask.

Step 2 Pipette 25.0 cm^3 of the solution from Step 1 into a conical flask and add an excess of aqueous potassium iodide, $\text{KI}(\text{aq})$.

The copper(II) ions react with iodide ions to form a precipitate of copper(I) iodide and a solution of iodine.



Step 3 Titrate the contents of the conical flask from Step 2 with $0.0800 \text{ mol dm}^{-3}$ sodium thiosulfate, $\text{Na}_2\text{S}_2\text{O}_3$, using starch as the indicator.



Step 4 Repeat Step 2 and Step 3 to obtain concordant titres and calculate the mean titre.

Results

Mean titre = 31.15 cm^3

21(d)(i) Calculate the percentage by mass of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ in Mixture A.

Give your answer to **3** significant figures.

Percentage of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ in Mixture A = %

[5 marks]

21(d)(ii) The student repeats their method, but after carrying out Step 1 they leave the solution exposed to the air for a few days.

Some of the iron(II) sulfate is oxidised to iron(III) sulfate.

The student then continues with Step 2, Step 3 and Step 4 of the method.

This mean titre is greater than 31.15 cm^3 .

Suggest why this mean titre is greater than 31.15 cm^3 .

[1 mark]

Q7 · June 2025 · Paper 3 (Unified chemistry) · Q4 · [15 marks]

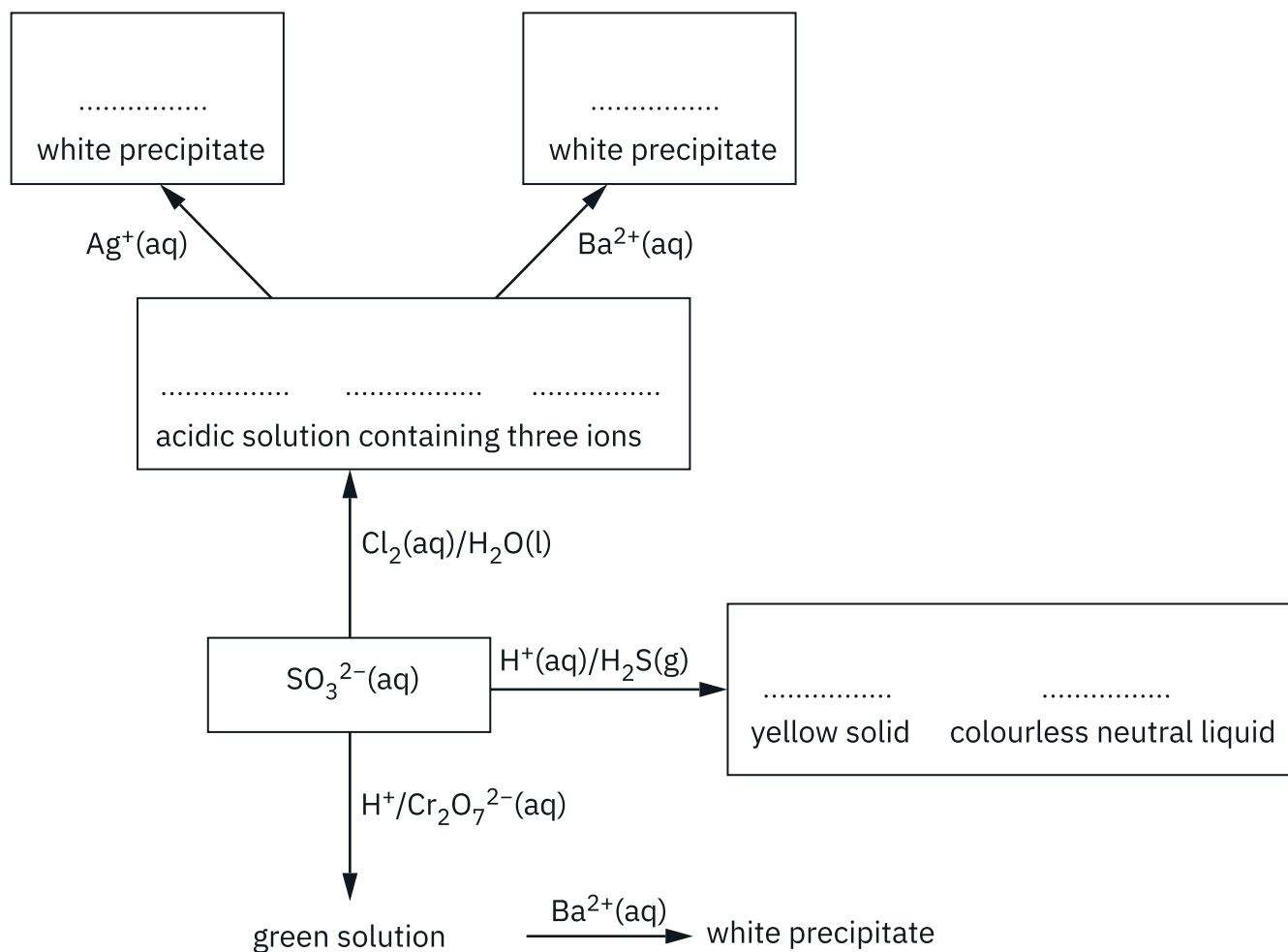
This question is about inorganic chemistry.

The flowchart shows reactions involving $\text{SO}_3^{2-}(\text{aq})$ ions.

4(a)(i) What is the systematic name of a SO_3^{2-} ion?

[1 mark]

4(a)(ii) Complete the flowchart by adding formulae in the boxes.

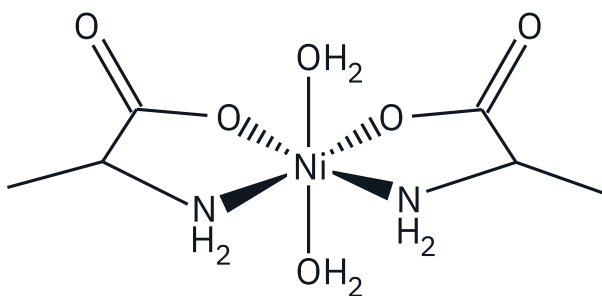


[7 marks]

4(a)(iii) Construct an ionic equation for the reaction of SO_3^{2-} with $\text{H}^+/\text{Cr}_2\text{O}_7^{2-}$.

[2 marks]

The structure of a neutral nickel(II) complex, A, is shown below.



Complex A

4(b)(i) What is the empirical formula of complex A?

[1 mark]

4(b)(ii) Complex A can be prepared by reacting an aqueous solution of nickel(II) sulfate with amino acid B and potassium hydroxide.

Aqueous nickel(II) sulfate contains the octahedral hexaaquo complex ion C.

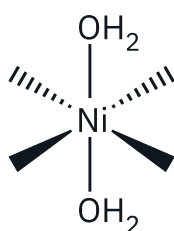
Draw the structure of amino acid B and the 3D structure, including the overall charge, of complex ion C.

Amino acid B

Complex ion C

[3 marks]

4(b)(iii) Complete the 3D diagram below to show a stereoisomer of complex A.



[1 mark]

Draw your answer on the figure above.

Q8 · November 2020 · Paper 1 (Periodic table, elements and physical chemistry) · Q15 · [1 mark]

Which statement(s) for the complex ion $[\text{Co}(\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2)_3]^{2+}$ is/are correct?

1 It has cis and trans isomers.

2 It has optical isomers.

3 It is six-fold coordination.

Tick (✓) one box.

☐ **A** 1, 2 and 3

☐ **B** Only 1 and 2

☐ **C** Only 2 and 3

☐ **D** Only 1

Q9 · November 2020 · Paper 3 (Unified chemistry) · Q2 · [6 marks]

2 Transition metal ions can bond to ligands to form complex ions with different shapes.

Explain what is meant by the terms ligand, coordination number and ligand substitution, using suitable examples of complex ions with different shapes, limited to monodentate ligands.

Your answer should include diagrams and equations where appropriate.

[6 marks]

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Mark scheme:

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