OCR A-Level Chemistry A

Transition elements mark scheme · goes with “Transition elements” · whiteboardchemistry.com/revision/exam-questions/ocr-a-level-chemistry/

Mark schemes

Transition elements · 9 questions

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

Answer: **C**

Only 2 and 3

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

Answer: **B**

Only 1 and 2

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

Answer: **D**

Only 1

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

Answer: **D**

$FeSO_4$

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

Answer: **B**

Only 1 and 2

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

OCR MARK SCHEME

21(a)(i)

Fe $(1s^2)\ 2s^2 2p^6 3s^2 3p^6 3d^6 4s^2$ ✓

$Cu^{2+}\ (1s^2)\ 2s^2 2p^6 3s^2 3p^6 3d^9$ ✓

[2 marks]

EXAMINER GUIDANCE

ALLOW *$(1s^2)\ 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$*

ALLOW *upper case letter S and P, and subscripts,*

e.g. $2S_2 2P_5$

IGNORE *$(4s^0)$*

IGNORE *electron configuration of copper under the line. Treat as working*

DO NOT ALLOW *[Ar] as shorthand for* $(1s^2)\ 2s^2 2p^6 3s^2 3p^6$

21(a)(ii)

Green precipitate ($FeSO_4$) ✓

(Pale) blue precipitate ($CuSO_4$) ✓

ALLOW *1 mark for both correct colours stated without precipitate mentioned*

ALLOW *ppt / solid*

DO NOT ALLOW *dark blue for* $CuSO_4$

[2 marks]

21(b)(i)

ALLOW *lone pair for electron pair*

Donates one/an electron pair (to a metal ion)

AND forms one/a dative (covalent) / coordinate bond (to a metal ion) ✓

[1 mark]

21(b)(ii)

ALLOW *other methods*

ALLOW $FeC_{20}H_{20}N_4Cl_2$ ***OR*** $Fe(C_5H_5N)_4Cl_2$ *for ratio*

$$\text{Fe} = \frac{12.6}{55.8} : \text{C} = \frac{54.3}{12} : \text{H} = \frac{4.5}{1} : \text{N} = \frac{12.6}{14} : \text{Cl} = \frac{16.0}{35.5}$$

$= 0.226 : 4.525 : 4.5 : 0.900 : 0.451$

$1 : 20 : 20 : 4 : 2$ ✓

$FeC_{20}H_{20}N_4Cl_2$ ✓

CORRECT empirical formulae subsumes ratio mark

DO NOT ALLOW $Fe(C_5H_5N)_4Cl_2$ *for* $FeC_{20}H_{20}N_4Cl_2$ *(not the empirical formulae)*

(pyridine ligands =) Four / 4 ✓

(coordination number =) Six / 6 ✓

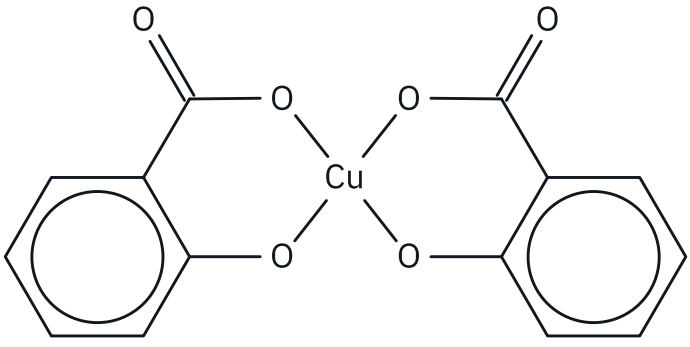
[4 marks]

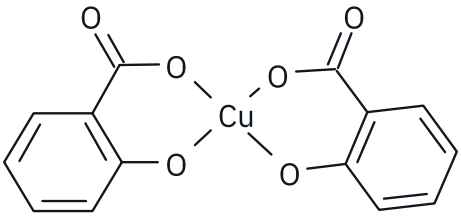
21(c)

IGNORE *charge and brackets*

ALLOW

Cis isomer





ALLOW *geometric*

ALLOW *E/Z*

Cis/trans ✓

[2 marks]

21(d)(i)

ALLOW ECF *throughout*

ALLOW 3 SF *up to calculated value*

IGNORE *rounding errors after 3 SF*

FIRST CHECK THE ANSWER ON ANSWER LINE

If answer = 65.4% award 5 marks

$n(S_2O_3^{2-}) = \frac{31.15 \times 0.0800}{1000} = 2.492 \times 10^{-3}$ ✓

$n(Cu^{2+})$ in 25 cm^3 = 2.492×10^{-3}

OR $n(I_2) = 1.246 \times 10^{-3}$ ✓

$n(Cu^{2+})$ in 250 cm^3 = 2.492×10^{-2} ✓

Mass $CuSO_4.5H_2O$ in mixture A = $2.492 \times 10^{-2} \times 249.6$

= 6.22(0032) g ✓

$\% = \frac{6.22 \times 100}{9.51}$ = 65.4 % (3 SF required) ✓

[5 marks]

Common Errors

4 marks

65.2%	(use of 249 rather than 249.6)
41.8%	(use of 159.6 ($CuSO_4$))
32.7%	(no use of second ratio)
6.54%	(no x 10)

21(d)(ii)

Iron(III) / Fe^{3+} reacts with iodide ions (I^-) to form iodine (I_2)

OR

Iron(III) / Fe^{3+} oxidises I^- ✓

[1 mark]

ALLOW ORA

ALLOW *(because) Iron(III) is reduced by /reacts with thiosulfate*

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

OCR MARK SCHEME

4(a)(i)

sulfate(IV) (ion) ✓

IV essential

[1 mark]

EXAMINER GUIDANCE

ALLOW *sulphate(IV)*

ALLOW *sulfite* ***OR*** *sulphite*

DO NOT ALLOW *'oxide' in name:*

e.g. sulfur trioxide **OR** sulfur(IV) oxide

4(a)(ii)

For top left box, **ALLOW** Ag_2SO_4

All responses must be formulae.

DO NOT ALLOW *'sulfur' for S*

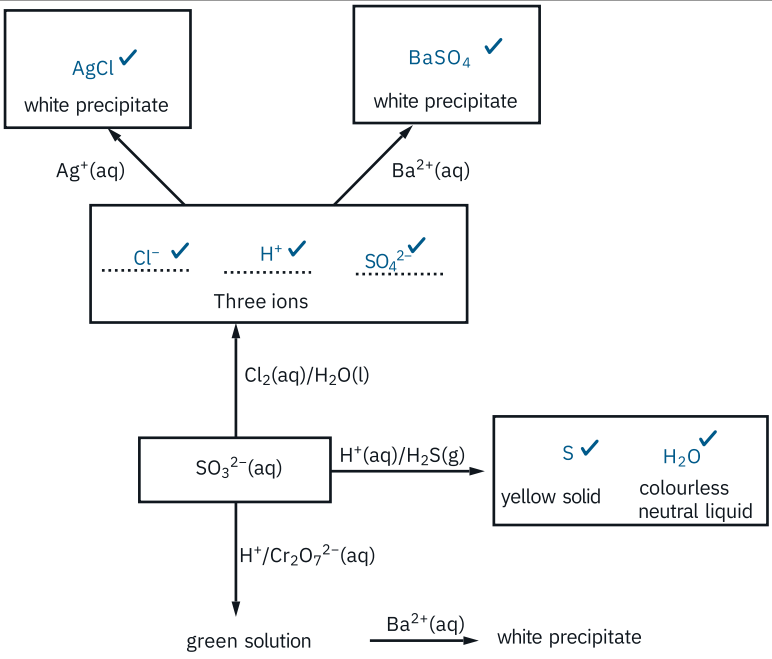
ALLOW *3 ions from the following 5 ions:*

H^+ **OR** H_3O^+, Cl^-, ClO^-, HSO_4^-, SO_4^{2-}

MUST be ions

ALLOW S_8

DO NOT ALLOW S_2



[7 marks]

4(a)(iii)

$3SO_3^{2-} + Cr_2O_7^{2-} + 8H^+ \rightarrow 2Cr^{3+} + 3SO_4^{2-} + 4H_2O$

SO_3^{2-} and $Cr_2O_7^{2-}$ on left-hand side

AND Cr^{3+} + SO_4^{2-} on right hand side ✓

Correct balanced equation ✓

DO NOT ALLOW *additional incorrect Cr or S species in equation, e.g.* Cr^{2+}, $Cr(OH)_3$, $[Cr(OH)_6]^{3-}$

ALLOW *multiples*

IGNORE *state symbols*

ALLOW $Cr_2(SO_4)_3$ *for 2* Cr^{3+} + 3 SO_4^{2-}

ALLOW $Cr^{3+} + H_2SO_4$ *on right-hand side*

ALLOW $[Cr(H_2O)_6]^{3+}$ *for* Cr^{3+}

DO NOT ALLOW $[Cr(OH)_6]^{3-}$

[2 marks]

4(b)(i)

$C_6H_{16}N_2NiO_6$ ✓

Any order

Count: 5 elements in formula

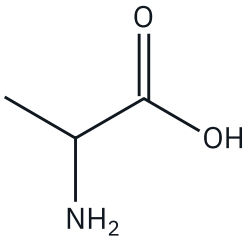
MUST be empirical formula

DO NOT ALLOW
$Ni(C_3H_6NO_2)_2(H_2O)_2$

ALLOW $C_6H_{16}N_2Ni_1O_6$ *i.e. 1 after Ni*

[1 mark]

4(b)(ii)

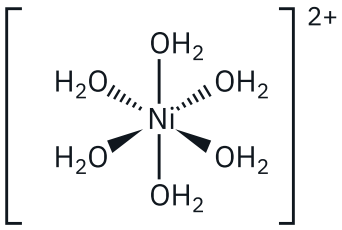


In amino acid

- **ALLOW** any combination of skeletal **OR** structural **OR** displayed formula as long as unambiguous
- **IGNORE** connectivity

Amino acid B

1 mark ✓



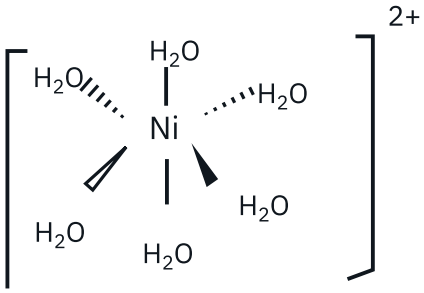
Complex ion C

2 marks

- Ni and 6 H_2O ligands in 3D structure (see guidance) ✓
- 2+ charge **AND** connectivity to 6 O in H_2O ligands ✓

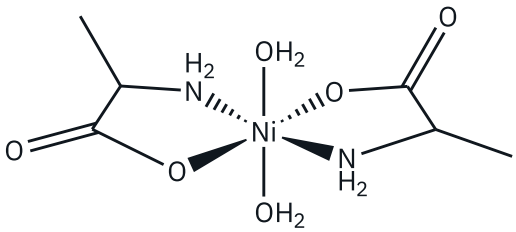
'O' connectivity ONLY needed for 2nd complex ion mark

i.e. This response gets 1st mark point: Ni, 6H_2O and 3D



[3 marks]

4(b)(iii)

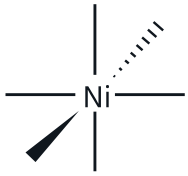


✓

In Complex ion C

- 3D: Must contain 2 'out wedges', 2 'in wedges' and 2 lines in plane of paper
- **OR** 4 lines, 1 'out wedge' and 1 'in wedge':

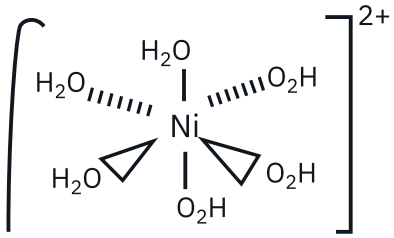
ALLOW *following geometry*



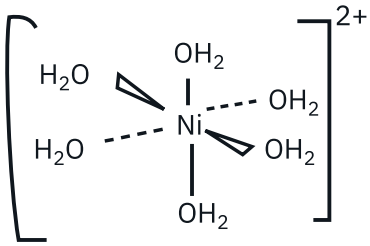
For bond into paper, **ALLOW**:



DO NOT ALLOW *–O_2H for 1st complex ion mark, e.g.*



DO NOT ALLOW *for 1st complex ion mark (impossible 3D)*



IGNORE *connectivity to NH_2*

IGNORE *3D Optical isomer in amino acid*

Watch for adjacent Os

[1 mark]

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

Answer: **C**

Only 2 and 3

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

OCR MARK SCHEME

2

Level 3 (5-6 marks)

Comprehensive explanation of the terms, ligand and coordination number and ligand substitution

AND

3D diagrams of suitable examples of 6 **AND** 4 coordinate complex ions with different shapes

AND

Ligand substitution illustrated with a balanced equation

There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.

Level 2 (3-4 marks)

Explanation of the terms, ligand and coordination number and ligand substitution with some errors or omissions

AND:

Diagrams of suitable examples of 6 **AND** 4 coordinate complex ions with different shapes

OR

A 3D wedged diagram of a suitable example of 6 **OR** 4 coordination

OR

A diagram of a suitable example of 6 **OR** 4 coordination

AND ligand substitution illustrated with an equation

OR

Ligand substitution illustrated with a balanced equation

There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence

Level 1 (1-2 marks)

EXAMINER GUIDANCE

Indicative scientific points may include:

Terms

- Ligand: Donates a lone pair to metal ion

Forms dative covalent (coordinate) bond with metal ion

- Coordination number: Number of coordinate bonds to metal ion. Could be implicit in annotated diagrams

***NOTE:** For monodentate ligands, 'number of ligands' is the same as the number of coordination number*

- Ligand substitution: One ligand replacing another

Suitable examples of complex ions with different shapes

- Coordination no 6

Octahedral e.g. $[Cu(H_2O)_6]^{2+}$, $[Fe(H_2O)_6]^{3+}$

- Coordination no 4

Tetrahedral e.g. $CuCl_4^{2-}$, $CoCl_4^{2-}$

OR Square planar Pt complexes, e.g. $Pt(NH_3)_2Cl_2$

Diagrams and equations

- Diagrams of complex ions (may be 3D)
- Equation for ligand substitution

Explanation of some terms: ligand, coordination number and ligand substitution with some errors or omissions.

AND

A suitable example of a complex ion **OR** Ligand substitution illustrated with an equation with some errors

There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.

0 marks

No response or no response worthy of credit.

[6 marks]

e.g. $[Cu(H_2O)_6]^{2+} + 4Cl^- \rightarrow CuCl_4^{2-} + 6H_2O$

$[Cu(H_2O)_6]^{2+} + 4NH_3 \rightarrow [Cu(NH_3)_4(H_2O)_2]^{2+} + 4H_2O$

NOTE: *A clear and logically structured response would link shapes with some of: coordination number, names of shapes, connectivity, involvement of lone pairs, bond angles, etc. (not inclusive)*

ALLOW *minor slips*

NOTE: Levels and the mark within a level is a 'best-fit', not perfection

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