Practice paper - Set 1

A Level Chemistry A
H432/01 Periodic table, elements and physical chemistry

MARK SCHEME

Duration: 2 hour 15 minutes

MAXIMUM MARK 100

Final

This document consists of 22 pages

MARKING INSTRUCTIONS

PREPARATION FOR MARKING

SCORIS

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *scoris assessor Online Training*; *OCR Essential Guide to Marking*.

2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal http://www.rm.com/support/ca

3. Log-in to scoris and mark the **required number** of practice responses (“scripts”) and the **required number** of standardisation responses.

   YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING

1. Mark strictly to the mark scheme.

2. Marks awarded must relate directly to the marking criteria.

3. The schedule of dates is very important. It is essential that you meet the scoris 50% and 100% (traditional 50% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.

4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the scoris messaging system.

5. Work crossed out:

   a. where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks

   b. if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.

7. There is a NR (No Response) option. Award NR (No Response)

   - if there is nothing written at all in the answer space

   - OR if there is a comment which does not in any way relate to the question (e.g. ‘can’t do’, ‘don’t know’)

   - OR if there is a mark (e.g. a dash, a question mark) which isn’t an attempt at the question.

   Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).

8. The scoris **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**

   If you have any questions or comments for your Team Leader, use the phone, the scoris messaging system, or email.

9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:

Read through the whole answer from start to finish, concentrating on features that make it a stronger or weaker answer using the indicative scientific content as guidance. The indicative scientific content indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance.

Using a 'best-fit' approach based on the science content of the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, **best** describes the overall quality of the answer using the guidelines described in the level descriptors in the mark scheme.

Once the level is located, award the higher or lower mark.

The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.

The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.

In summary:

- **The science content determines the level.**
- **The communication statement determines the mark within a level.**

Level of response questions on this paper are **18a** and **19a**.

11. Annotations

Annotation	**Meaning**
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

12. **Subject-specific Marking Instructions**

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

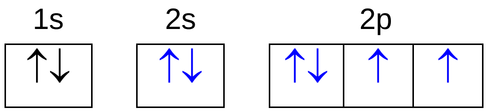
You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

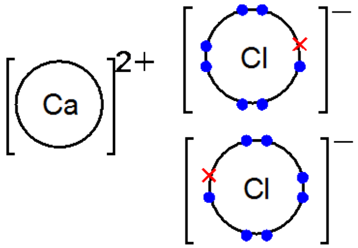
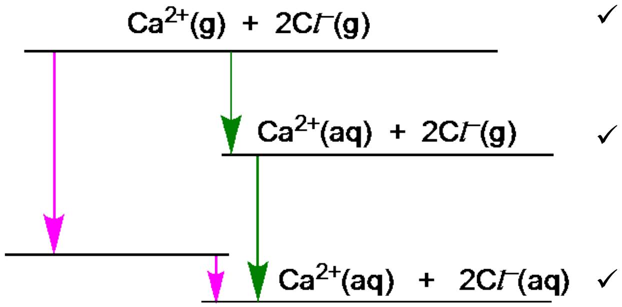
SECTION A

Question	Answer	Marks	Guidance
1	D	1	
2	C	1	
3	A	1	
4	B	1	
5	B	1	
6	C	1	
7	C	1	
8	D	1	
9	D	1	
10	C	1	
11	B	1	
12	A	1	
13	B	1	
14	A	1	
15	D	1	
	Total	15	

SECTION B

Question			Answer	Marks	Guidance
16	**(a)**		 ✓	**1**	**ALLOW** unpaired electrons in last two boxes pointing down.
	(b)	**(i)**	$Na^{6+}(g) \rightarrow Na^{7+}(g) + e^{-}$ ✓ *State symbols must be included*	**1**	**ALLOW** $Na^{6+}(g) - e^{-} \rightarrow Na^{7+}(g)$ **ALLOW** e for electron (i.e. charge omitted) **IGNORE** state with e^{-}
		(ii)	radius decreases **AND** attraction between (the remaining) electrons and nucleus increases ✓	**1**	**ALLOW** same number of protons attract fewer electrons **ALLOW** electron removed from increasing + ion **IGNORE :** atomic/ionic before radius electron shielding/repulsion decreases effective nuclear charge increases
		(iii)	large difference/increase/rise shows a different/new shell ✓ large difference/increase/rise between 1st and 2nd IEs **AND** 9th and 10th IEs ✓	**2**	**ALLOW** energy level for shell **DO NOT ALLOW** sub-shell or orbital for 1st mark **ALLOW** a response that clearly shows where there is a large difference/increase, e.g. 'after 1st IE; before 2nd IE
		(iv)	Mg has (outer) electron in (3)s sub-shell **AND** Al has (outer) electron in (3)p sub-shell ✓ (3)p sub-shell has higher energy than (3)s sub-shell ✓	**2**	**ALLOW** Mg and Al has (outer) electron in different sub-shells
	(c)		**A**: Sc^{3+} ✓	**2**	

Question			Answer	Marks	Guidance
			B: S^{2-} ✓		
	(d)		C : H : N : O = $\frac{31.17}{12.0}$: $\frac{9.09}{1.0}$: $\frac{18.18}{14.0}$: $\frac{41.56}{16.0}$ = 2.5975 : 9.09 : 1.299 : 2.5975 ✓ = 2 : 7 : 1 : 2 Formula = $C_2H_7NO_2$ ✓ Ions: NH_4^+ and CH_3COO^- ✓	**3**	**ALLOW** $C_2H_3O_2^-$ for CH_3COO^-
			Total	**12**	

Question			Answer	Marks	Guidance
17	(a)		 Calcium ion with eight (or no) outermost electrons **AND** 2 × chloride (ions) with '*dot-and-cross*' outermost octet ✓ correct charges ✓	2	**For 1st mark**, if eight electrons are shown in the cation then the 'extra' electron in the anion must match symbol chosen for electrons in the cation **IGNORE** inner shell electrons Circles **not** essential **ALLOW 1 mark** for correct electron structure and charges but only one Cl drawn **ALLOW** (with electron structure) $2[Cl^-]$ $2[Cl]^-$ $[Cl^-]2$ (brackets not required) **DO NOT ALLOW** $[Cl_2]^-$ $[Cl_2]^{2-}$ $[2Cl]^{2-}$ $[Cl]^{2-}$
	(b)		**solution**: (enthalpy change for) 1 mole of a compound/substance/solid/solute dissolving (in water) ✓	1	**IGNORE** 'energy released' **OR** 'energy required' For dissolving, **ALLOW** forms aqueous/hydrated ions **DO NOT ALLOW** dissolving elements **IGNORE** ionic **OR** covalent **DO NOT ALLOW** response that implies **formation** of **1 mole** of aqueous ions
	(c)	(i)		3	Correct species **AND** state symbols required for each mark. (mark independently) On middle line, **ALLOW** $Ca^{2+}(g) + 2Cl^-(aq)$ (i.e. Cl^- hydrated before Ca^{2+}) On bottom line, **ALLOW** $CaCl_2(aq)$

Question			Answer	Marks	Guidance
		(ii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **IF** answer = –142 (kJ mol^{-1}) award 2 marks **--–** $\Delta_{sol}H$ ($CaCl_2$) = [–1616 + (2 × –359)] – (–2192) **OR** – 2334 + 2192 ✓ = –142 ✓ (kJ mol^{-1})	2	**IF** there is an alternative answer, check to see if there is any **ECF** credit possible using the working shown. **IF ALL 3 relevant values from the information at the start of Q3 have NOT been used, award zero marks unless one number has a transcription error, where 1 mark can be awarded ECF**
		(iii)	***Comparison of size*** $Ca^{2+} > Mg^{2+}$ ✓ ***Comparison of charge*** $Na^{+} < Mg^{2+} < Al^{3+}$ ✓ ***Comparison of attraction between ions*** size **AND** charge linked to greater attraction **to H_2O** ✓	3	**IGNORE** comparison of size: $Na^{+} > Mg^{2+} > Al^{3+}$
	(d)	**(i)**	**FIRST CHECK THE ANSWER ON ANSWER LINE** **IF** answer = –132 (kJ mol^{-1}) award 4 marks --– Correctly calculates energy released in J **OR** kJ = 50.21 × 4.18 × 31.5 = 6611 (J) **OR** 6.611 (kJ) ✓ Correctly calculates $n(CaCl_2)$ $= \frac{5.56}{111.1}$ = 0.05(00) mol ✓ Correctly calculates ΔH value in J **OR** kJ In J: $= (–)\frac{6611}{0.0500}$ **OR** (–)132,220 (J) **OR** In kJ: $= (–)\frac{6.611}{0.0500}$ **OR** (–)132.22 (kJ) ✓ *(Sign ignored and/or more than 3 SF)*	4	**FULL ANNOTATIONS MUST BE USED** **--** **ALLOW** calculator value of 6611.1507 down to 3SF value of 6610 **DO NOT ALLOW** fewer than 3 SF **IGNORE** units for this mark, i.e. just **ALLOW** correctly calculated number in either J or kJ **ALLOW ECF** from $n(CaCl_2)$ **AND/OR** Energy released **IGNORE** absence of – sign and 3 SF requirement

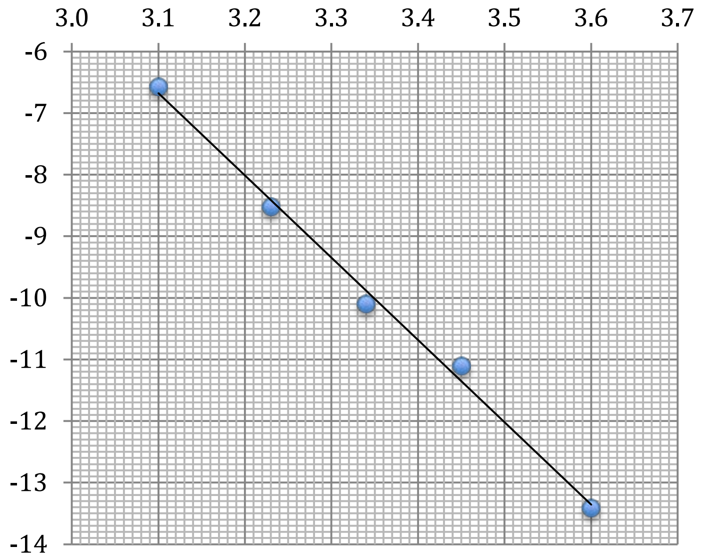
Question			**Answer**	**Marks**	**Guidance**
			Correct $\Delta_{sol}H$ in kJ **AND** sign **AND** 3SF = –132 (kJ mol^{-1}) ✓		Final mark requires – sign, kJ **AND** 3 SF
		(ii)	Temperature change is double / × 2 / 63ºC **AND** $\Delta_{sol}H$ is the same ✓ Twice the energy produced in the same volume **AND** **ratio** of energy produced to mass or number of moles is the same **OR** $\frac{q}{n}$ is the same ✓	**2**	**ALLOW** temperature reached would be 85^{o}C
			Total	**17**	

Question			Answer	Marks	Guidance
18	**(a)***		*Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.* **Level 3 (5–6 marks)** A comprehensive conclusion which correctly links pressure to moles, temperature to ΔH **AND** correctly identifies problems with use of low temperature and high pressure with reasons **AND** explains one benefit of using a catalyst *There is a well-developed conclusion showing a line of reasoning which is clear and logically structured, linking pressure and temperature with equilibrium shift to the right, giving two reasons for operational conditions different and a positive sustainability comment from use of catalyst.* **Level 2 (3–4 marks)** Reaches a simple conclusion that correctly links pressure to moles, temperature to ΔH Correctly identifies problems with use of low temperature and high pressure with at least one reason **OR** explains one benefit of using a catalyst *The conclusion has a line of reasoning presented with some structure, linking pressure and temperature with equilibrium shift to the right and either giving two reasons for problems and a positive sustainability comment from use of catalyst.* **Level 1 (1–2 marks)** Reaches a simple conclusion that correctly links pressure to moles, temperature to ΔH. **OR** explains one benefit of using a catalyst	**6**	**Indicative scientific points may include:** **MAXIMUM EQUILIBRIUM YIELD** **Pressure**: • Right-hand side has fewer number of (gaseous) moles **Temperature**: • (Forward) reaction is exothermic **/**gives out heat **OR** reverse reaction is endothermic **/**takes in heat **Conditions AND equilibrium shift** • Low temperature **AND** high pressure **AND** equilibrium (position) shifts to right **ACTUAL CONDITIONS** • Low temperature give slow rate **OR** high temperatures to increase rate • High pressure is expensive **OR** high pressure provides a safety risk **CATALYST**: **ONE** benefit from: • reactions take place at lower temperatures with lower energy demand OR reduce CO_2 emissions/burning fossil fuel

Question			**Answer**	**Marks**	**Guidance**
			The information selected is communicated in an unstructured way which links pressure and temperature with equilibrium shift to the right. **0 marks** No response or no response worthy of credit.		
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **IF** answer = 0.812 $dm^6\ mol^{-2}$, award **6 marks** **IF** answer = 0.812 with incorrect units, award **5 marks** --- **Equilibrium amounts in mol** **2 MARKS** $n(N_2)$ = 0.62(0) ✓ $n(H_2)$ = 1.86 ✓ **Equilibrium concentrations in mol dm^{-3} (mol ÷ 5)** **1 MARK** N_2 = 0.124 **AND** H_2 = 0.372 **AND** NH_3 = 0.072 ✓ **Calculation of K_c and units** **3 MARKS** $K_c = \frac{[NH_3(g)]^2}{[N_2(g)] \times [H_2(g)]^3}$ **OR** $\frac{0.072^2}{0.124 \times 0.372^3}$ ✓ = 0.812 ✓ $dm^6\ mol^{-2}$ ✓ *At least 3SF is required*	6	**FULL ANNOTATIONS NEEDED** **IF** there is an alternative answer, check to see if there is any **ECF** credit possible using working below -- **ALLOW ECF** from incorrect moles of N_2, H_2 **AND/OR** NH_3 **ALL three** concentrations required for mark **ALLOW ECF** from incorrect concentrations **OR** use of moles (omitting conc stage) **NO ECF** for numerical value with a square **AND/OR** cube missing For K_c, **ALLOW** 3 significant figures up to calculator value of 0.8121093077 correctly rounded For units, **ALLOW** $mol^{-2}\ dm^6$ **DO NOT ALLOW** dm^6/mol^{-2}

Question			Answer	Marks	Guidance
					--- **COMMON ERRORS** 0.0325 ***3 marks + units mark*** from N_2 = 0.620, H_2 = 1.86, NH_3 = 0.360 (mol)
	(c)	**(i)**	**IGNORE** le Chatelier responses --- ***Each marking point is independent*** ***K_c*** K_c does not change (with pressure/ concentration) ✓ ***Comparison of conc terms with more N_2*** $[N_2]$ increases **OR** denominator/bottom of K_c expression increases ✓ ***yield of NH_3 linked to K_c*** Chemist is correct **AND** denominator decreases **OR** numerator increases to restore equilibrium K_c ✓	**3**	**FULL ANNOTATIONS NEEDED** **ALLOW** K_c **only** changes with temperature **IF** 1st marking point has been awarded, **IGNORE** comments about 'K_c decreasing' or 'K_c increasing' and assume that this refers to how the ratio subsequently changes. i.e **DO NOT CON** 1st marking point.
		(ii)	N_2 obtained from the air **AND** H_2 must be manufactured/does not occur naturally ✓	**1**	N_2 is more readily available **not** insufficient. **ALLOW** an example of H_2 manufacture, e.g. from oil/gas/water **BOTH** responses required for mark.
			Total	**16**	

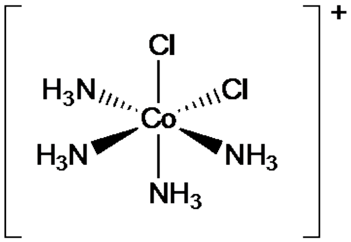
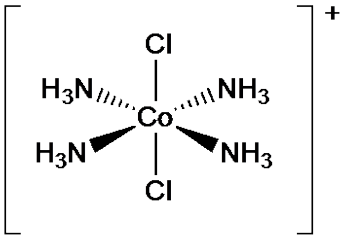
Question			Answer	Marks	Guidance
19	**(a)**		*Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.* **Level 3 (5–6 marks)** A comprehensive conclusion which uses quantitative results for determination of the reaction orders **AND** determination of *k* with units **AND** proposes the two-step mechanisms *There is a well-developed conclusion showing a line of reasoning which is clear and logically structured. The working for orders, rate equation, rate constant and two-step mechanism are clearly linked to the experimental evidence.* **Level 2 (3–4 marks)** Reaches a sound, but not comprehensive, conclusion based on the quantitative results. Correctly identifies the orders and rate equation **AND** calculates the rate constant with units **OR** proposes the two-step mechanism *The conclusion has a line of reasoning presented with some structure. The working for orders, rate equation **AND** rate constant **OR** the two-step mechanism are linked to the experimental evidence.* **Level 1 (1–2 marks)** Reaches a simple conclusion for orders **AND** rate equation . *The working for orders, and rate equation are linked to the experimental data, but the evidence may not be clearly shown.* **0 marks** No response or no response worthy of credit.	**6**	**Indicative scientific points may include:** **Orders and rate equation** • NO_2 and O_3 both 1st order **OR** *rate* = $k[O_3]$ $[NO_2]$ • Supported by experimental results **Calculation of *k*, including units** • *k* correctly calculated **AND** correct units, i.e. $k = 1.28 \times 10^{-2}$ • $dm^3 mol^{-1} s^{-1}$ **OR** $mol^{-1} dm^3\ s^{-1}$ **Two-step mechanism** • Two steps add up to give overall equation • Slow step/ rate-determining step matches stoichiometry of rate equation. e.g. $O_3 + NO_2 \rightarrow O_2 + NO_3$ rate-determining step $NO_3 + NO_2 \rightarrow N_2O_5$ **OR** $O_3 + NO_2 \rightarrow 2O_2 + NO$ rate-determining step $NO + O_2 + NO_2 \rightarrow N_2O_5$

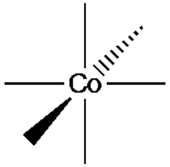
<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td>**(b)**</td><td></td><td>
<table>
<tr><th>Temperature, T /K</th><th>Rate constant, k / s^{-1}</th><th>$1/T$ / K^{-1}</th><th>ln k</th></tr>
<tr><td>278</td><td></td><td></td><td></td></tr>
<tr><td>290</td><td></td><td>**3.45×10^{-3}**</td><td></td></tr>
<tr><td>298</td><td></td><td></td><td></td></tr>
<tr><td>308</td><td></td><td></td><td>**–8.52**</td></tr>
<tr><td>323</td><td></td><td></td><td></td></tr>
</table>
two missing values: 3.45×10^{-3} **AND** –8.52 ✓
all points plotted correctly
AND
best straight line drawn through points ✓
gradient = $\pm 1.36 \times 10^{4}$ ✓
acceptable range: 1.30–1.40 $\times 10^{4}$
multiplication by 8.314
AND
division by 10^3 to give E_a = (+)113 (kJ mol^{-1}) ✓</td><td>**4**</td><td>

ALLOW mark for gradient if correct working shown within E_a calculation without gradient being calculated separately
ALLOW ECF from value of gradient
BUT
DO NOT ALLOW ‘–‘ sign for E_a</td></tr>
<tr><td></td><td></td><td></td><td>**Total**</td><td>**10**</td><td></td></tr>
</table>

Question			**Answer**	**Marks**	**Guidance**
20	**(a)**	**(i)**	HNO_3 is a strong acid **AND** HNO_2 is a weak acid ✓	**1**	**ALLOW** HNO_3 completely dissociates **AND** HNO_2 partially dissociates **ALLOW** $HNO_3 \rightarrow H^+ + NO_3^-$ **AND** $HNO_2 \rightleftharpoons H^+ + NO_2^-$ **IGNORE** HNO_3 is a stronger acid **ORA** **IGNORE** HNO_3 produces more H^+
		(ii)	pH = –log 0.0450 = 1.35 (**2 DP** required) ✓	**1**	
		(iii)	**FIRST CHECK THE ANSWER ON ANSWER LINE** **IF** answer = 2.35, award all **three** calculation marks $K_a = 10^{-3.35}$ **OR** 4.47×10^{-4} ($mol\ dm^{-3}$) ✓ $[H^+] = \sqrt{(K_a \times [HNO_2])}$ **OR** $\sqrt{(K_a \times [HA])}$ **OR** $\sqrt{(K_a \times 0.0450)}$ **OR** 4.48×10^{-3} ($mol\ dm^{-3}$) ✓ pH = 2.35 (**2 DP** required) ✓	**3**	**ALLOW** 2 SF to calculator value: $4.466835922 \times 10^{-4}$, correctly rounded **IGNORE** HNO_3 in working Always **ALLOW** calculator value irrespective of working as number may have been kept in calculator. ***Note****: pH = 2.35 is obtained from all three values above* *From no square root, pH = 4.70. Worth K_a mark only*
	(b)		**FIRST CHECK THE ANSWER ON ANSWER LINE** **IF** answer = 0.810 (g) award 4 marks $[H^+] = 10^{-12.500} = 3.16 \times 10^{-13}$ ($mol\ dm^{-3}$) ✓ $[OH^-] = \frac{K_w}{[H^+]} = \frac{1.00 \times 10^{-14}}{3.16 \times 10^{-13}} = 0.0316$ ($mol\ dm^{-3}$) ✓ $n(RbOH) = 0.0316 \times \frac{250}{1000} = 7.91 \times 10^{-3}$ (mol) ✓ mass RbOH = $7.91 \times 10^{-3} \times 102.5 = 0.810$ (g) ✓	**4**	Always **ALLOW** calculator value irrespective of working as number may have been kept in calculator. **ALLOW** alternative approach using pOH: pOH = 14.000 – 12.500 = 1.500 ✓ $[OH^-] = 10^{-1.500} = 0.0316$ ✓ **ALLOW ECF** from $[H^+]$ derived using K_w and $[OH^-]$ BUT **DO NOT ALLOW** an acid pH. **ALLOW** 0.81 g, up to calculator value but take care as

Question			**Answer**	**Marks**	**Guidance**
					rounding could be from any stage *Last 3 SF figure is zero and is treated as a ‘trailing zero’ as specific number of SF has not been asked for*
	(c)		Element oxidised: sulfur/S 0 to +6 ✓ Element reduced: nitrogen/N +5 to +4 ✓ $6HNO_3 + S \rightarrow 6NO_2 + H_2SO_4 + 2H_2O$ Correct species ✓ Balance ✓	**4**	**ALLOW** 5+, 4+ and 6+ Signs required **ALLOW** $4H^+ + 6NO_3^- + S \rightarrow 6NO_2 + SO_4^{2-} + 2H_2O$
			Total	**13**	

Question			**Answer**	**Marks**	**Guidance**
21	**(a)**		Cr: $(1s^22s^22p^6)3s^23p^63d^54s^1$ ✓ Cr^{3+}: $(1s^22s^22p^6)3s^23p^63d^3$ ✓	**2**	**ALLOW** 4s before 3d, ie $1s^22s^22p^63s^23p^64s^13d^5$ **ALLOW** $1s^2$ written after answer prompt (*ie* $1s^2$ twice) **ALLOW** upper case D, etc and subscripts, e.g. ……$4S_13D_5$ **ALLOW** for Cr^{3+} **……….**$4s^0$ **DO NOT ALLOW** [Ar] as shorthand for $1s^22s^22p^63s^23p^6$ Look carefully at $1s^22s^22p^63s^23p^6$ – there may be a mistake
	(b)		*Formula of complex ion **J*** Structures show correct ligands (4 NH_3 **AND** 2 Cl) **AND** 1+ charge (on at least one structure) ✓ *Stereoisomers*  ✓ *cis*  ✓ *trans* **NOTE**: For each structure, bonding from Co must be to **N** of NH_3 *cis* and *trans* labels required for both structure marks. If structures are correct but labels are wrong way round or omitted, award 1 out of the 2 stereoisomer marks	**3**	***FULL ANNOTATIONS MUST BE USED*** **---** For two stereoisomer marks, **IGNORE** charges (**anywhere**) *Charge already credited within the 1st mark.* Square brackets **NOT** required 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’: For bond into paper, **ALLOW**:  **ALLOW** following geometry throughout:

Question			Answer	Marks	Guidance
			TAKE CARE: structures may be in different orientations.		
	(c)	**(i)**	**A**: $Cr_2(SO_4)_3$ ✓ **B**: MnI_2 ✓ State symbols **not** required in equations (within observations). **C**: $Cr^{3+} + 3OH^– \rightarrow Cr(OH)_3$ ✓ **D**: $[Cr(H_2O)_6]^{3+} + 6NH_3 \rightarrow [Cr(NH_3)_6]^{3+} + 6H_2O$ ✓ **E**: $Mn^{2+} + 2OH^– \rightarrow Mn(OH)_2$ ✓ **F**: $Ba^{2+} + SO_4^{2–} \rightarrow BaSO_4$ ✓ **G**: $Ag^+ + I^– \rightarrow AgI$ ✓	**7**	**Formulae required in question** **IGNORE** incorrect names **IGNORE** incorrect state symbols **ALLOW** $[Cr(H_2O)_6]^{3+} + 3OH^– \rightarrow Cr(OH)_3(H_2O)_3 + 3H_2O$ **ALLOW** $Cr(OH)_3(H_2O)_3 + 6NH_3 \rightarrow [Cr(NH_3)_6]^{3+} + 3H_2O + 3OH^–$ **ALLOW** $[Mn(H_2O)_6]^{2+} + 2OH^– \rightarrow Mn(OH)_2(H_2O)_4 + 2H_2O$
		(ii)	removes/reacts with carbonate/$CO_3^{2–}$ **AND** carbonate forms a (white) precipitate ✓	**1**	**Both** statements required for the mark **Note**: 2nd statement can be for Test 2 (Ba^{2+}) **OR** Test 3 (Ag^+)
		(iii)	**Test 2**: no difference ✓	**3**	

Question			Answer	Marks	Guidance
			Test 3 gives a white precipitate by reaction with C*l*⁻ ✓ **A**: white precipitate **AND** **B**: white/yellow ppt **OR** cream ppt **OR** paler yellow ppt ✓		
		(iv)	Add **concentrated** ammonia/NH_3 **AND** yellow precipitate does **not** dissolve ✓	**1**	**Concentrated** essential for NH_3
			Total	**17**	