Mark scheme

Question			Answer/Indicative content	Marks	Guidance
1		i	$Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$ ✓	1	***ALL*** *3 state symbols required* **Examiner's Comments** Candidates were required to write a straightforward ionic equation that they would have encountered many times during the A Level Chemistry course. It was surprising that only just over half the candidates produced an equation that could be given. Common errors included the following. • Omission of state symbols or incorrect state symbols, especially (aq) in $AgCl(s)$. • Inclusion of nitrate ions or use of $AgNO_3$ instead of Ag^+. • An equation using Cl_2 and forming $AgCl_2$. Some candidates used the ideal gas equation to determine the moles of hydrogen, choosing suitable values for temperature and pressure. This approach was allowed, although the exercise would have wasted candidate time compared to the much simpler division by 24 for using RTP, which is stated in the question.
		ii	***n*($AgNO_3$) 1 mark** $= 2.50 \times 10^{-2} \times 60.0/1000 = 1.5(0) \times 10^{-3}$ (mol) ✓ **Essential mark** **Formula 2 marks** **Ratio** 5.00×10^{-4} mol **A** contains $1.5(0) \times 10^{-3}$ mol Cl **OR**	3	**Check equation from 2b(i) at top of response** -- **ALLOW** 1:3 or 3:1 ratio seen anywhere, e.g. XCl_3 **ALLOW ECF** from formula of silver chloride in **2b(i)** e.g. From $AgCl_2$ $n(Cl) = \mathbf{2} \times 1.5(0) \times 10^{-3} = 3.(00) \times 10^-$

			ratio A : Cl = 1.5(0) × 10^{-3} ÷ 5.00 × 10^{-4} = 1 : 3 ✓ **Formula** = $AlCl_3$ ✓ Automatically subsumes 1:3 ratio mark ✓ **ALLOW** Al_2Cl_6 **ALLOW** PCl_3		^{3} (mol) ratio = 1 : 6 Formula = SCl_6 **<u>Examiner's Comments</u>** Most candidates determined the moles of $AgNO_3$ and hence Ag^+ as 1.50 × 10^{-3} mol. This was given 1 mark, but candidates then needed to use this amount to predict the identity of compound **A**. Most candidates could not see the way forward and many received only 1 mark. Many candidates had worked out 'something' from the supplied data, without knowing where this initial step would take them. Candidates needed to spot that the ratio of the element : C*l* in compound **A** was 5 × 10^{-4} : 1.50 × 10^{-3} or 1 : 3. The correct formula of A*l*C*l*$_3$ then follows. MgC*l*$_2$ was a common error obtained by subtracting 5 × 10^{-4} from 1.50 × 10^{-3} to obtain a 1 : 2 ratio. This question would be a good exercise for improving the application skills of candidates.
			Total	**4**	
2			**B**	1	**<u>Examiner's Comments</u>** Overall, candidates had little difficulty with this question and most selected B. Options C and D were the main distractors, with few choosing option A. The question did not discriminate well across the ability range, suggesting that many candidates guessed.
			Total	**1**	
3			**A**	1	**<u>Examiner's Comments</u>** About half of the candidates chose A correctly. Most candidates wrote oxidation numbers below the chlorine

					in the equations, which is good practice, with C proving to be the main distractor. Note also the point made in Question 6 about underlining the word '**not**'.
			Total	**1**	
4		i	killing bacteria ✓	1	**ALLOW** killing microorganisms / microbes / sterilises water **IGNORE** 'removing' bacteria **Examiner's Comments** Candidates performed well on this question with most knowing that Cl_2 kills the bacteria. Some stated that chlorine removed bacteria or purified the water.
		ii	$Cl_2 + 2Br^- \rightarrow Br_2 + 2Cl^-$ ✓ Chlor<u>ine</u> is more reactive than brom<u>ine</u> **AND** iod<u>ine</u> is less reactive than brom<u>ine</u> **OR** chlor<u>ine</u> is a stronger oxidising agent than brom<u>ine</u> **AND** iod<u>ine</u> is a weaker oxidising agent than brom<u>ine</u>. ✓	2	**DO NOT ALLOW** full equation **IGNORE** state symbols **CARE** with endings (e.g. ide and ine) **ALLOW** ORA **ALLOW** reactivity C*l* > Br > I **ALLOW** brom<u>ide</u> is a stronger reducing agent than chlor<u>ide</u> **AND** brom<u>ide</u> is a weaker reducing agent than iod<u>ide</u> **IGNORE** displacement **IGNORE** references to down the group. **IGNORE** all comparisons of electron structure/electron affinity **Examiner's Comments** Most students scored the equation mark, although some presented unbalanced equations. Nearly all candidates used the ionic equation. Explanations were well argued with most candidates using the order of reactivity. A few considered the oxidising power of the halogen. Candidates are advised to ensure that both comparisons are clearly made, and it is obvious which of the

					two halogens the response is referring to. It is also important that candidates can distinguish between a halogen and a halide. Some candidates explained in terms of electronegativity and displacement. **OCR support** We have produced a teacher and delivery guide to assist with learning about the reaction of group 7 elements and their compounds: [Teach Cambridge (ocr.org.uk)]
			Total	**3**	
5			**D**	1	**Examiner's Comments** The correct answer was D. This proved a more challenging question. Successful candidates often presented oxidation numbers above the equations to identify the element that was simultaneously oxidised and reduced. Most candidates recognised that A and B could be ruled out, with C being the most common error.
			Total	**1**	
6			**C**	1	**Examiner's Comments** The correct answer was C. This question was answered well, alongside Q2. Candidates should aim to separate explanations regarding chemical and physical properties. B was a common wrong answer and a few candidates suggested that the covalent bonds need to be broken, selecting A.
			Total	**1**	
7			F ✓	1 (AO 1.1)	**Examiner's Comments** Although most candidates did choose

					F, a substantial number chose Br (most common), K and H, seemingly confused between gaining and losing electrons in forming ions.
			Total	**1**	
8			**B**	1 (AO 1.1)	**<u>Examiner's Comments</u>** Almost all candidates selected the correct response of B. The main distractor proved to be D, the other type of dipole–dipole interaction.
			Total	**1**	
9	a		**Level 3 (5–6 marks)** A comprehensive explanation of relative reactivities of chlorine and iodine **AND** Uses an appropriate method to calculate volume of seawater allowing for **an** **acceptable error** *There is a well-developed line of reasoning which is clear an d logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** A comprehensive explanation of relative reactivities of chlorine and iodine **AND** Some attempt at calculation **OR** Explanation of relative reactivities of chlorine and iodine containing **most** details **AND** A reasonable attempt at calculation **OR** Explanation of relative reactivities of chlorine and iodine containing **some** details **AND** Uses an appropriate method to calculate volume of seawater allowing for **an** **acceptable error** *There is a line of reasoning presented*	6 (AO 1.1 × 2) (AO 1.2 × 1) (AO 2.6 × 3)	*Indicative scientific points may include:* **Explanation of relative reactivities** Comparison required throughout • Chlorine gains electron more easily **OR** forms negative ion more easily **OR** attracts an electron (to its outer shell) more easily • Because chlorine (atom) is smaller **OR** outer shell of chlorine less shielded/closer • Greater nuclear attraction (on chlorine electrons) • **ORA** **IGNORE** 'nuclear charge' for 'nuclear attraction' **Determination of volume of seawater** • $Cl_2(g) + 2I^-(aq) \rightarrow I_2(aq) + 2Cl^-(aq)$ **OR** molar ratio $I^-: I_2$ = 2:1 • $n(I_2) = \frac{1 \times 10^6}{253.8}$ = 3940(.11…) (mol) • n(KI) = 3940(.11…) × 2 = 7880.(22…) (mol) • n(KI) in 1 dm^3 seawater = $\frac{0.150}{166}$ = 9.036(144..) × 10^{-4} (mol)

			with some structure. The information presented is relevant and supported by some evidence. **Level 1 (1–2 marks)** Explanation of relative reactivities of chlorine and iodine containing **some** details **AND** Some attempt at the calculation **OR** Explanation of relative reactivities containing **most** details **OR** A reasonable attempt at calculation *The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.* **0 mark** *No response or no response worthy of credit.*		• Volume of seawater $= \frac{7880.(22..)}{9.036(...) \times 10^{-4}}$ = 8.72…… × 10^6 dm^3 **Alternative method:** • m(KI) = 7880.(22…) x 166 (mol) = 1.308(116627) x 10^6 • Volume of seawater $= \frac{1.308(116627) \times 10^6}{0.15}$ = 8.72…… × 10^6 dm^3 **Acceptable errors:** Volume of seawater obtained from: • Use of 126.9 to find n(I_2) giving 1.74….x 10^7 • Missing x 2 ratio giving 4.36….x 10^6 **DO NOT ALLOW** for L3 if both errors are present, please note it gives a volume of 8.72…… × 10^6 dm^3 **ALLOW** minor slips in rounding, transcription errors, etc throughout **<u>Examiner's Comments</u>** Very few candidates managed to access the higher level on this question. They found the calculation very challenging. In addition to a typical mole calculation, they needed to use the tonnes conversion (given on the data sheet), look at the ratio of I_2 to KI and use a mass concentration. Many used the mass concentration as a molar concentration. Even if a balanced equation was given, it didn't guarantee the correct ratio in calculations and a common error was to find moles of I_2 using the relative atomic mass of iodine (126.9). As with previous calculations on this paper, it was often challenging to follow the logic in the steps of the calculation. It is important to encourage candidates to label each step of their calculation, showing

					them as independent steps and only using = when terms are equal. Explanations of relative reactivities of chlorine and iodine often lacked detail or had extra irrelevant information, such as reference to electronegativity, ionisation energy, bond enthalpy or intermolecular forces. Some candidates gave responses for the general trend in reactivity in the group rather than comparing Cl and I. Confusion around nuclear charge and nuclear attraction was also often seen. A key skill for longer answer questions is to plan out answers to avoid contradictions. Candidates should also be encouraged to re-read their answers to check that what they have written makes sense. Exemplar 2  The reason chlorine is more reactive than iodine is because of its atomic structure. Chlorine has less electrons and so has fewer shells. It also has a smaller atomic radius than iodine. Because of this the attraction of the nucleus to the outer electrons in chlorine is stronger, therefore chlorine can gain an electron easier so it is more reactive than iodine. $2KI + Cl_2 \rightarrow 2KCl + I_2$ Additional answer space if required. This exemplar demonstrates a L3 6 mark response. A comprehensive explanation of relative reactivities of chlorine and iodine is given. The steps in the calculation are logical with each step labelled, making it easy to follow. A balanced equation is also given.
	b		**Disproportionation** Oxidation **AND** reduction of same element/chlorine **OR**	3 (AO 1.1) (AO 2.2) (AO 2.2)	**IGNORE** numbers around equation for oxidation numbers **IGNORE '**species' or 'reactant' for element **ALLOW** 1+ for +1 **AND** 1– for –1 **NOTE** for chlorine/Cl2 **from 0** only

<table>
<tr>
<td></td>
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<td>Chlorine/Cl/Cl_2 has been oxidised AND
chlorine/Cl/Cl_2 has been reduced ✓
Oxidation

from 0 in Cl_2 to +1 in $Ca(OCl)_2$ OR ClO^- ✓
Reduction

from 0 in Cl_2 to –1 in $CaCl_2$ OR Cl^- ✓</td>
<td></td>
<td>needs to be seen once, does not need to be stated twice

ALLOW 1 mark for 3 oxidation numbers correct but no mention of words oxidation/reduction: e.g.

0 in Cl_2 AND –1 in $CaCl_2$ AND +1 in $Ca(OCl)_2$
ALLOW 1 mark for species missing

oxidised from 0 to +1
AND reduced (from 0) to –1

<u>Examiner's Comments</u>

Most were able to explain the term disproportionation. Some missed the mark by not stating an element or chlorine. A very common error was giving final oxidation numbers of Cl as +2 and/or -2, rather than per atom. The link between oxidation number and species was not always clearly indicated or changes not specified as oxidation/reduction (or given as the wrong way round). It is vital to set out answer s clearly showing oxidation numbers, species and stating if oxidised or reduced. It is not enough to write on the equation given in the question as it often challenging to read these numbers, or they contradict the main answer. Some attempted to show that Ca has been disproportionated.</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td>i</td>
<td><table><tr><th>Haloalkane</th><th>Formula</th><th>Colour</th><th></th></tr><tr><td>2-bromopropane</td><td>AgBr</td><td>cream</td><td>✓</td></tr><tr><td>2-iodopropane</td><td>AgI</td><td>yellow</td><td>✓</td></tr></table>
Formula AND colour required for each mark</td>
<td>2
(AO 1.1 x 2)</td>
<td>ALLOW 1 mark if correct formula for both OR correct colour for both

<u>Examiner's Comments</u>

The majority of candidates scored both marks. Some scored 1 mark only mainly for correct colours of the precipitates but with incorrect formulae. Common errors included $AgBr_2$ and AgI_2, giving the formula of the haloalkane or formulae involving a halogen and a nitrate ion.</td>
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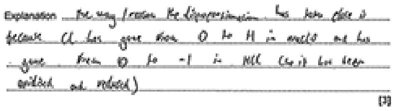
<tr>
<td></td>
<td></td>
<td>ii</td>
<td>AgI OR yellow (precipitate forms first)</td>
<td>1
(AO2.3)</td>
<td>ALLOW (precipitate from) 2-iodopropane</td>
</tr>
</table>

			AND C–I bond is weaker (than C–Br bond) ✓		**ALLOW** ECF from incorrect formula or colour ppt from 3(d)(ii) **ALLOW** C–I bond has a lower bond enthalpy **OR** C–I bond is longer **ORA** **IGNORE** references to bond length, polarity and electronegativity **Examiner's Comments** Most responses did not gain credit here. Some recognised that AgI would form first but then gave an incorrect reason (such as 'held by weaker London forces') or their answers lacked detail (e.g., 'weaker bonds' without specifying which bonds). Many said AgBr because Br is more reactive or more electronegative.
			Total	**12**	
10	a	i	Oxidation and reduction of the same **element**✓ 'Atom' is insufficient for element	1 (AO1.1 ×1)	**ALLOW** 'chlorine' **OR** '*Cl*' for same element **IGNORE** 'species' for 'element' **Examiner's Comments** Candidates answered this question well and most were given the mark. Where candidates didn't receive credit, it was mainly because they used the term 'same atom' instead of 'same element'. Some less successful responses responded with completely incorrect chemistry and had clearly not learnt this specification content.
		ii	**Equation** $Cl_2 + 2NaOH \rightarrow NaClO + NaCl + H_2O$ ✓ **Redox:** *Cl* is oxidised from 0 (in Cl_2) to +1 in Na*Cl*O ✓ *Cl* is reduced from 0 (in Cl_2) to -1 in Na*Cl*/H*Cl* ✓ **IGNORE** oxidation numbers shown in	3 (AO2.6×1) (AO2.1×2)	**DO NOT ALLOW** $Cl_2 + NaOH \rightarrow NaClO + HCl$ **ALLOW ECF** from HCl in equation **ALLOW** 1 out of 2 redox marks if NaClO AND NaCl omitted, i.e. *Cl* is oxidised from 0 to +1 **AND** *Cl* is reduced from 0 to -1 **ALLOW** 1 out of 2 redox marks if oxidation number changes are **BOTH**

			equation *(treat as rough working)* **BUT** If **no** oxidation numbers in explanation, *look at equation for oxidation numbers*		correct ...BUT reduction/oxidation is incorrectly assigned, i.e. C*l* is reduced from 0 (in Cl_2) to +1 in NaC*l*O C*l* is oxidised from 0 (in Cl_2) to -1 in NaC*l*/HC*l* **General: ALLOW number before sign in ox no, i.e.** 1+ for +1 1- for -1 **IGNORE** ionic charges, e.g. Cl^{1+} **IGNORE** '1' (signs required) **IGNORE** references to electron loss/gain (even if wrong) **<u>Examiner's Comments</u>** Candidates found the equation hard, despite this reaction being specification content and the inclusion in the earlier part of the stem of 'NaClO' as one product. The correct response required candidates to realise that NaCl would be a product and to balance the resulting equation. Some did not add the balancing '2' before NaOH, and many selected HCl as the second product, a compound that would react further with NaOH to produce NaCl. The explanation worked the same whether NaCl or HCl had been identified as the second product. There were some excellent responses, providing the correct oxidation number changes, linking these to the species involved and identifying the changes as either oxidation or reduction. Two explanation marks were available with marks not being given for omission of one of the three features described above. Exemplar 2  This exemplar has been included to emphasise the points made above. It was only possible to award this response 1/3 marks. The equation shows the common error of the second chlorine-containing product

					being HCl and not NaCl: 0 marks The candidate has identified the oxidation number changes and has linked these to the correct species. The last statement in brackets is correct but the candidate has not communicated which oxidation number change is oxidation and which is reduction: 1/2 marks
	b		**Identification of halide** Add (aqueous) silver nitrate **OR** $AgNO_3$ **OR** Ag^+/silver ions ✓ **Observations - mark independently** Chloride/Cl^- gives white precipitate Bromide/Br^- gives cream precipitate Iodide/I^- gives yellow precipitate ✓ **Precipitate/solid seen at least once** **Equation for at least one halide** e.g. $Ag^+ + Cl^- \rightarrow AgCl$ **ALLOW** $Ag^+ + X^- \rightarrow AgX$ ✓ ***IGNORE*** *state symbols (ppt already assessed)* **Identification of B and C** **B**: NaBr **OR** sodium bromide ✓ **C**: $CaCl_2$ **OR** calcium chloride ✓	5 (AO3.3×3 AO3.2×2)	**ANNOTATE ANSWER WITH TICKS AND CROSSES** **IGNORE** addition of HNO_3 but HCl **CONs** $AgNO_3$ **IGNORE** references to solubility in NH_3 (dil or conc), even if incorrect **ALLOW** chlorine for chloride, etc **ALLOW** equation with Br^- **OR** I^- e.g. $Ag^+ + Br^- \rightarrow AgBr$ **ALLOW** full/partial equations, e.g. $AgNO_3 + Cl^- \rightarrow AgCl + NO_3^-$ **ALLOW** explanation for identification: i.e. **B (Group 1):** Subtract molar/atomic mass of halide/Br from number in range 100–115/molar mass of B ✓ **C (Group 2):** Subtract **2** × molar/atomic mass of halide/Cl from number in range 100–115/molar mass of **C** ✓ **ALLOW** displacement by addition of halogen ✓ 2 correct colours in water or organic solvent ✓ Equation, e.g. $Cl_2 + 2Br^- \rightarrow Br_2 + 2Cl^-$ ✓ **<u>Examiner's Comments</u>** Candidates generally answered the first part of this question well. Most candidates were able to identify silver nitrate (or a halogen displacement method), to describe the expected observations, supported with mainly correct ionic equations. Candidates found it much harder to identify B and C as NaBr and $CaCl_2$. They could do this in various ways by matching possible formula with the provided molar mass ranges. The mark scheme did allow marks to be given when candidates described the

					identification process, although this was often very muddled, so, only the most able few candidates fully identified the unknown B and C.
			Total	**9**	
11			**D**	1(AO1.1)	**Examiner's Comments** This question was direct recall of specification content and most candidates selected D as the correct answer.
			Total	**1**	
12			**D**	1(AO2.7)	**Examiner's Comments** This question proved to be difficult, with only the most able candidates selecting the correct answer of D. A was often given as an incorrect answer as candidates recognised that AgCl would be the only halide precipitate to show a change with dilute ammonia but did not realise that as it would redissolve, it would be the only one not in the filtrate.
			Total	**1**	
13		i	**FIRST CHECK ANSWER ON THE ANSWER LINE** **If answer = 2.19 χ 10^{-3} award 3 marks** --- ***n*(Cl_2)** = 420/24 = 17.5 (mol) ✓ ***n*($Ca(ClO)_2$)** = $\frac{17.5}{2}$ = 8.75 (mol) ✓ Concentration $Ca(ClO)_2$ $= \frac{8.75}{4 \times 1000}$ = **2.19 χ 10^{-3}** (mol dm^{-3}) ✓ **3SF AND standard form**	3 (3 ×AO2.2)	Use of ideal gas equation for all 3 marks provided 'sensible' *p* and *T* used: e.g. from 101 kPa and 298 K → *n* = 17.122 → 2.14 χ 10^{-3} from 100 kPa and 298 K → *n* = 16.952 → 2.12 χ 10^{-3} Examples of 'sensible' *p* = 100 kPa, 101 kPa, 101,325 Pa *T* = 273 - 298 K **ALLOW ECF** ----------------------------------- **Common errors** 4.38 χ 10^{-3} (no ÷ 2) → 2 marks 2.19 χ 10^{n} → 2 marks 4.38 χ 10^{n} → 1 mark 2.2 χ 10^{-3} → 2 marks *not appropriate SF*

					Examiner's Comments Most candidates calculated the amounts of Cl_2 and $Ca(ClO)_2$ correctly as 17.5 mol and 8.75 mol respectively. Only the least successful did not use the equation's stoichiometry to halve 17.5 to 8.75. For the final step in the calculation, candidates needed to convert 4.00 m^3 into 4000 dm^3 and to then determine the concentration to an appropriate number of significant figures and standard form. As all the data had been provided to 3 significant figures, the final answer was also required to 3 significant figures, as 2.09×10^{-3} mol dm^{-3}. Answers such as 2.2×10^{-3}, 2.1875×10^{-3} and 2.19×10^{-6} and 0.00219 illustrate errors in these areas.
		ii	**Equation** $3\ Ca(ClO)_2 \rightarrow 2\ CaCl_2 + Ca(ClO_3)_2$ ✓ **Reduction** C*l* reduced from +1 to -1 ✓ **Oxidation** C*l* oxidised from +1 to +5 ✓ *+1 starting oxidation number seen once* *Cl required for both explanation marks* **IGNORE** oxidation numbers shown below/above equation *(treat as rough working)* **BUT** If **no** oxidation numbers in explanation, *look at equation for oxidation numbers*	3 (AO2.6) (2 ×AO1.2)	**ALLOW** multiples **ALLOW** $3\ ClO^- \rightarrow 2\ Cl^- + ClO_3^-$ **ALLOW** 1 out of 2 redox marks if oxidation number changes are **BOTH** correct **...BUT** reduction/oxidation is incorrectly assigned, i.e. C*l* is oxidised from +1 to -1 C*l* is reduced from +1 to +5 **ALLOW** 1 out of 2 redox marks if oxidation changes correct but red and ox not stated C*l* **changes** from +1 to -1 C*l* **changes** from +1 to +5 -- **General:** **ALLOW number before sign in ox no, e.g.** 1- for -1 **IGNORE** ionic charges, e.g. Cl^{5+} **IGNORE** '1' (signs required) **IGNORE** references to electron loss/gain (even if wrong) **Examiner's Comments**

					Candidates were required to write a balanced equation from provided reactants and products and to use oxidation numbers to illustrate disproportionation. In the equation, the reactants and products were sometimes unbalanced, or incorrectly balanced. A common error was to balance the equation after first adding O_2 as an extra reactant. Illustrating disproportionation proved to be easier with the oxidation number changes from the initial +1 being required. Otherwise, more successful responses sometimes missed out on marks if they omitted detail. For example, the oxidation number changes were stated but the candidate omitted to state which change was oxidation and which was reduction. The best responses identified $Ca(ClO_3)_2$ as the oxidation product and $CaCl_2$ as the reduction product. One unexpected error on many scripts was for calcium to be identified as the element undergoing disproportionation, with oxidation number changes from +6 to +14 and +2. It was difficult to see why this happened, with Ca forming +2 compounds, but the error was common.
			Total	**6**	
14		i	Cl^- /It/They react with $AgNO_3$ / Ag^+ /silver ions **OR** $AgCl$ formed **OR** $Ag^+ + Cl^- \rightarrow AgCl$ ✓	1 (AO3.2)	**IGNORE** chlorine/Cl for chloride ion **IGNORE** $AgCl_2$ **<u>Examiner's Comments</u>** Almost all candidates realised that Cl^- ions would react with the added $AgNO_3$ at time = t_1.
		ii	$[CoCl_4^{2-}]$ decreases **AND** $[Co(H_2O)_6]^{2+}$ increases ✓ Cl^- increase is 4 × change in $[CoCl_4^{2-}]$ /	3 (2 ×AO3.1)	**IGNORE** missing charges and small slips in formulae, e.g. $CoCl_4$ missing bracket, etc **IGNORE** Cl^- for changes in

			$[Co(H_2O)_6]^{2+}$ ✓ Equilibrium shifts to right ✓	(1 ×AO3.2)	concentration **ALLOW** suitable alternatives for 'shifts to right', e.g. towards products **OR** in forward direction **OR** 'favours the right' **<u>Examiner's Comments</u>** In contrast with Question 4 (a), most candidates did interpret the graphical information provided and related this to the reduced concentration of $CoCl_4^{2-}$ ions and the increased concentration of $[Co(H_2O)_6]^{2+}$ ions. Most candidates also referred to Equilibrium 4.1 to conclude that the equilibrium shifts to the right. Only the very best candidates recognised that the increase in Cl^- concentration following the initial addition of $AgNO_3$ was 4 times greater than the increase in the concentration of $Co(H_2O)_6]^{2+}$, arising from the 4 : 1 ratio in the stoichiometry in the equation.
			Total	**4**	