Pearson

Mark Scheme
(Results)

Summer 2026

Pearson Edexcel GCE In Chemistry (9CH0)
Paper 01 Advanced Inorganic and Physical Chemistry

9CH0_01

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Summer 2026
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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Using the Mark Scheme

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing candidates to be rewarded for answers showing correct application of principles and knowledge. Examiners should therefore read carefully and consider every response: even if it is not what is expected it may be worthy of credit.

The mark scheme gives examiners:
• an idea of the types of response expected
• how individual marks are to be awarded
• the total mark for each question
• examples of responses that should NOT receive credit.

/ means that the responses are alternatives and either answer should receive full credit.
( ) means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.
Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.
ecf/TE/cq (error carried forward) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

Candidates must make their meaning clear to the examiner to gain the mark. Make sure that the answer makes sense. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

Quality of Written Communication
Questions which involve the writing of continuous prose will expect candidates to:
• write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
• select and use a form and style of writing appropriate to purpose and to complex subject matter
• organise information clearly and coherently, using specialist vocabulary when appropriate.
Full marks will be awarded if the candidate has demonstrated the above abilities.
Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

Question Number	Answer	Mark
1(a)(i)	**The only correct answer is D** (the energy required to remove 1 mol of electrons from 1 mol of gaseous atoms) ***A*** *is not correct because this is an endothermic not an exothermic process* ***B*** *is not correct because it is incomplete as there is no mention of the gaseous state or the removal of electrons* ***C*** *is not correct because this is an endothermic not an exothermic process*	**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
1(a)(ii)	An explanation that makes reference to the following points: • because the atomic number / proton number / number of protons in the nucleus increases (by 1 so attraction increases) **(1)** • and the **electron**(s) removed are in the same shell / sub-shell **(1)**	Penalise ionic radii once only Allow nuclear charge increases Allow have similar / same shielding Allow have similar / same repulsion (by inner electrons so are less easily lost) Ignore smaller atomic radius	**(2)**

Question Number	Answer	Mark
1(a)(iii)	**The only correct answer is C** (the electron is removed from a fully occupied orbital) ***A*** *is not correct because the outer electrons of H and J are in the same shell* ***B*** *is not correct because the outer electrons of H and J are in the same sub-shell* ***D*** *is not correct because there is another electron in the orbital that the electron is being removed from, which causes repulsion*	**(1)**

Question Number	Answer	Mark
1(b)(i)	**The only correct answer is D** (elements E and N) ***A*** *is not correct because there is not a big drop in ionisation energy from element H to element J, which would be expected if the elements were in Group 2* ***B*** *is not correct because there is not a big drop in ionisation energy from element A to element B and element J to element K, which would be expected if the elements were in Group 2* ***C*** *is not correct because D and M are the first elements of the periods and so are in Group 1, not Group 2*	**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
1(b)(ii)	An answer that makes reference to the following points: • this will be the second element in that period/shell so the largest drop in ionisation energy should be for the element immediately beforehand	Accept 'a large drop' instead of 'the largest drop' Accept D has the lowest ionisation energy of the period so is in Group 1, meaning that E is in Group 2 Accept largest drop between C and D and L and M indicating new period and so E is Group 2 No TE from (b)(i)	**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
1(c)	An answer that makes reference to the following points: • as element D must be in Group 1 / has the lowest ionisation energy in the next period (therefore must be in Group 6) **(1)** • cannot be another Group 6 element as there would be many elements with similar ionisation energies between elements E and F (therefore must be in period 2) **(1)** • therefore A is oxygen **(1)**	Each mark is standalone Accept alternative explanations for group such as C is a noble gas / is in Group 8/0 other explanation for why Group 6 such as 3 elements back from large drop Accept there are no transition metal ionisation energies in the graph/ no d block elements on graph	**(3)**

(Total for Question 1 = 9 marks)

Question Number	Answer	Mark
2(a)(i)	**The only correct answer is D** (saturated solution of potassium nitrate) ***A*** *is not correct because this contains chloride ions which may react and the solution is not saturated* ***B*** *is not correct because this contains iodide ions which may react and the solution is not saturated* ***C*** *is not correct because this contains bromide ions which may react with the contents of one of the cells*	**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
2(a)(ii)	An answer that makes reference to the following points: • pressure of 100 kPa **(1)** • temperature of 298 K / 25 ºC **(1)** • **all** solutions of concentration 1 mol dm^{-3} **(1)**	Allow 1 atm / 101 kPa	**(3)**

Question Number	Answer	Mark
2(b)(i)	**The only correct answer is B** (an aqueous solution of sulfuric(IV) acid) ***A*** *is not correct because this is the oxidising agent in a half-equation* ***C*** *is not correct because this is the oxidising agent in a half-equation* ***D*** *is not correct because although this is a reducing agent, it is in a more positive half-cell so is a weaker reducing agent*	**(1)**

Question Number	Answer	Mark
2(b)(ii)	**The only correct answer is C** (purple) ***A*** *is not correct because this is the colour of* VO^{2+} ***B*** *is not correct because this is the colour of* V^{3+} ***D*** *is not correct because this is the colour of* VO_2^+	**(1)**

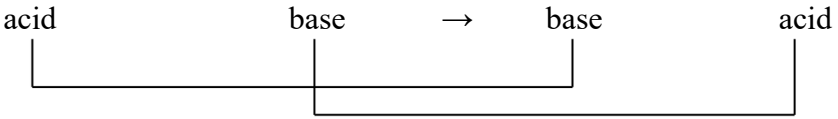
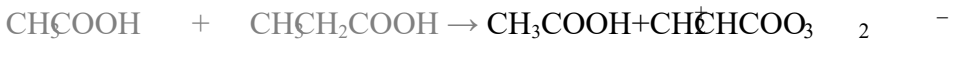
Question Number	Acceptable Answer	Additional Guidance	Mark
2(c)(i)	An answer that makes reference to the following points: • VO^{2+} is formed (via V^{3+}) **(1)** • calculation of E^{θ}_{cell} for V^{2+} to V^{3+} **and** statement that (E^{θ}_{cell} is positive so) reaction is feasible **(1)** • ionic equation for V^{2+} to V^{3+} **(1)** • calculation of E^{θ}_{cell} for V^{3+} to VO^{2+} **and** statement that (E^{θ}_{cell} is positive so) reaction is feasible **(1)** • ionic equation for V^{3+} to VO^{2+} **(1)** • calculation of E^{θ}_{cell} from VO^{2+} to VO_2^{+} **and** statement that (E^{θ}_{cell} is negative so) reaction is not feasible **(1)**	Allow ⇌ for → Ignore state symbols, even if incorrect Ignore V^{4+} only $E\theta cell = +0.47 - -0.26 = (+)0.73$ (V) Allow correct value with no working $SO_3^{2-} + 6H^+ + 4V^{2+} \rightarrow 4V^{3+} + 2S + 3H_2O$ $E\theta cell = +0.47 - +0.34 = (+)0.13$ (V) Allow correct value with no working $S_2O_3^{2-} + 4V^{3+} + H_2O \rightarrow 4VO^{2+} + 2H^+ + 2S$ $E\theta cell = (+)0.47 - (+)1.00 = -0.53$ (V) Ignore ionic equation even if incorrect Allow correct comparison of the values from table for the calculation of the E^{θ}_{cell} value with statement on feasibility Penalise the lack of reference to **feasibility** once only in M2, M4 or M6	**(6)**

Question Number	Acceptable Answer		Additional Guidance	Mark
2(c)(ii)	An answer that makes reference to the following points: • (the purple solution turns green then) turns blue • a yellow solid / precipitate / ppt / ppte (of sulfur) is formed	**(1)** **(1)**	Ignore initial colour even if incorrect Allow yellow crystals	**(2)**

(Total for Question 2 = 14 marks)

Question Number	Acceptable Answer	Additional Guidance	Mark
3(a)(i)	An answer that makes reference to the following points: • that partially / incompletely ionises / dissociates (at low concentrations) **(1)** • a compound that is a proton donor **(1)**	Allow ionises or dissociates to a small extent Allow produces / forms / releases H^+ / HO^+_3 / hydroxonium / oxonium / hydronium ions Allow dissociation equation Allow electron pair acceptor Ignore reactions of acid, e.g. neutralises base	**(2)**

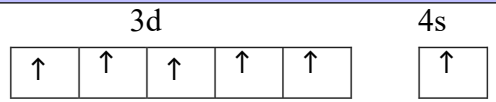
Question Number	Acceptable Answer	Additional Guidance	Mark
3(a)(ii)	An answer that makes reference to the following points: • methanoic acid is the strongest **(1)** • because it has the lowest pK_a value / because it has the highest Ka value **(1)** • so the dissociation / equilibrium is furthest to the right **(1)**	M2 dependent on M1 Allow has the largest [H+] Allow more dissociated If no mark out of the three awarded correct linkage between lowest pK_a value or the highest K_a value and degree of dissociation scores 1 mark	**(3)**

Question Number	Acceptable Answer	Additional Guidance	Mark
3(a)(iii)	• correct equation **(1)** • correct identification **(1)**	M2 is dependent on M1 or near miss  acid base conjugate base conjugate acid Allow withlineslinking,e.g.  Allow A1,B2→B1,A2 Allowforonemark (asethanoic is the stronger acid)  base acid conjugate acid conjugate base	**(2)**

Question Number	Acceptable Answer		Additional Guidance	Mark
3(b)			Example of calculation	(5)
	• rearrangement and substitution of values	(1)	$[H^+]^2 = Ka[CH_3COOH] = 1.74 \times 10^{-5} \times 0.1 = 1.74 \times 10^{-6}$	
	EITHER			
	• calculate $[H^+]$	(1)	$[H^+] = \sqrt{1.74 \times 10^{-5} \times 0.1} = 0.0013191 / 1.3191 \times 10^{-3}$ (mol dm^{-3})	
	• pH to 1 or 2 dp	(1)	$-\log [H^+] = 2.88 / 2.9$	
	OR			
	• find pH expression	(1)	$pH = ½K_a - ½\log [CH_3COOH]$	
	• pH to 1 or 2 dp	(1)	$-\log [H^+] = 2.88/ 2.9$	
			Final pH with or without working scores 3	
	• assumption 1	(1)	concentration of hydrogen ions due to dissociation of water is negligible / all H^+ comes from the acid or $[H^+] = [CH_3COO^-]$	
	• assumption 2	(1)	dissociation of ethanoic acid is negligible / very small / insignificant or $[CH_3COOH]_{initial} = [CH_3COOH]_{eqm}$	

Question Number	Acceptable Answer	Additional Guidance	Mark
3(c)	An answer that makes reference to the following points: • the mixture contains a large amount / (large) reservoir of **both** ethanoic acid and ethanoate ions / of $CHCOOH$ and $CHCOO^-$ **(1)** **For added acid** • added H^+ reacts with ethanoic acid to form ethanoate ions / $H^+ + CHCOO^- \rightleftharpoons CH_3COOH$ **(1)** **For added alkali** **EITHER** • added OH^- reacts with ethanoic acid to produce ethanoate ions **OR** • OH^- ion combines with H^+ to form water / $H+ + OH^- \rightarrow H_2O$ **and** ethanoic acid dissociates to form ethanoate ions **(1)** • ratio of ethanoate ions to ethanoic acid hardly changes **(1)**	Ignore comments about acid / base in relation to $CHCOOH$ / $CHCOO^-$ unless defined Allow $\rightarrow$ instead of $\rightleftharpoons$ Allow HO^+ throughout Allow sodium ethanoate/ salt for ethanoate ions Allow added H^+ combines with OH^- ions to form water / $H^+ + OH^- \rightarrow H_2O$ **and** ethanoate ion reacts with water to produce OH^- ions / $CHCOO^- + HO \rightleftharpoons CHCOOH + OH^-$ Allow salt:acid ratio Allow remains constant Allow pH is unchanged/ changes very little **because** added H^+ removed **and** change in concentration of ethanoic acid **and** ethanoate ion is small	**(4)**

(Total for Question 3 = 16 marks)

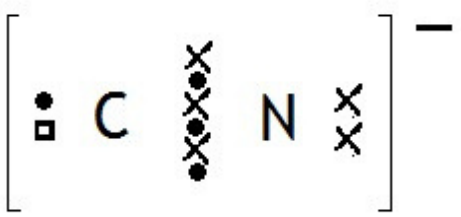
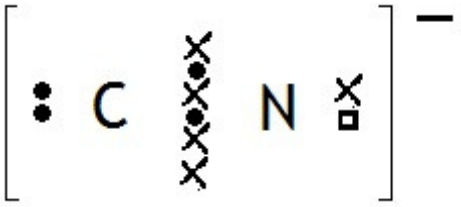
Question Number	Answer	Mark
4(a)	**The only correct answer is B**  ***A*** *is not correct because electrons go into empty orbitals before pairing up* *is not correct because there are empty orbitals in 3d that should be filled before pairing electrons in the 4s orbital* ***C*** *is not correct because there are empty orbitals in 3d that should be filled before pairing electrons in the 4s orbital*	**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
4(b)	An answer that makes reference to the following points: • (as a metal, chromium has) **delocalised** electrons **(1)** • which can move **and** carry (an electrical) charge **(1)**		**(2)**

Question Number	Acceptable Answer		Additional Guidance	Mark
4(c)	An answer that makes reference to the following points: • 104.5º	**(1)**	Allow angles between 104º and 105º	**(2)**
	• (repulsion between) two lone pairs of electrons and two bonded pairs of electrons (on the O) **and** lone pairs repel more than bonding pairs	**(1)**		

Question Number	Acceptable Answer		Additional Guidance	Mark
4(d)	An answer that makes reference to the following points: • dative covalent bond **and** between the chromium (ion) and the oxygen (atom of the water) **or** between the chromium (ion) and a chloride (ion / ligand)	**(1)**	Ignore hydrogen bonds as not within the compound Ignore just water Allow chlorine	**(3)**
	• ionic bond **and** between the positive complex ion and the negative chloride ion	**(1)**		
	• covalent bond **and** between the O and H atoms (in water /ligands or water of crystallisation)	**(1)**	Do not award covalent bond between Cl-Cl	

(Total for Question 4 = 8 marks)

Question Number	Acceptable Answer	Additional Guidance	Mark
5(a)(i)	An answer that makes reference to the following points: • triple bond between the C and the N **(1)** • rest of the structure correct with lone pairs on both the C and the N **(1)**	Example of diagram Allow dots and crosses swapped max 1 mark All electrons of the same symbol max 1 mark  Or  Allow electron pairs shown horizontally Charge may be on C or N or in bracketsas shown Ignore omission of negative sign Ignore circles Ignore horizontal lines for bonds Ignore brackets missing	**(2)**

Question Number	Answer	Mark
5(a)(ii)	**The only correct answer is B** (octahedral) ***A*** *is not correct because this is not a word used to describe a three-dimensional shape* ***C*** *is not correct because this is a shape taken up by complex ions with four ligands and this formula has six ligands* ***D*** *is not correct because this is a shape taken up by complex ions with four ligands and this formula has six ligands*	**(1)**

Question Number	Acceptable Answer		Additional Guidance	Mark
5(b)(i)	An answer that makes reference to the following points: • (increasing the concentration of alkali) makes the equilibrium in the second equation favour the left-hand side	**(1)**	M3 dependent on correct link from either M1 or M2	**(3)**
	• making the value of E^{θ} less positive until it is less than 0.56 V	**(1)**	Allow decreases / becomes more negative	
	• if the change is sufficient then E^{θ}_{cell} becomes positive (making the reaction feasible)	**(1)**	Allow ….E^{θ}_{cell} becomes more positive (making the reaction more feasible) allow less negative	

Question Number	Acceptable Answer	Additional Guidance	Mark
5(b)(ii)	An answer that makes reference to the following points: • (reverse disproportionation is when) two oxidation states of the same element, react together to form a product with one oxidation state that is in between the oxidation states of the reactants **(1)** • manganese in oxidation states +7 and +4 react to give +6 / Mn(VII) and Mn(IV) give Mn(VI) **(1)**	Allow in the reverse reaction the manganese in the same element is simultaneously oxidised and reduced Allow in the reverse reaction the same element reacts to give one higher and one lower oxidation state Allow Mn^{7+} and Mn^{4+} give Mn^{6+}	**(2)**

(Total for Question 5 = 8 marks)

Question Number	Acceptable Answer	Additional Guidance	Mark
6(a)	An answer that makes reference to the following points: • balanced equation **(1)** • state symbols **(1)**	$XCO_3(s) + 2HCl(aq) \rightarrow XCl_2(aq) + H_2O(l) + CO_2(g)$ Accept $XCO_3(s)+2H^+(aq) \rightarrow X2+ (aq) + H_2O(l) + CO_2(g)$	**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
6(b)(i)	An answer that makes reference to the following point: • so the XCO_3 can be added to the acid without having to remove the bung in the conical flask	Allow to avoid gas loss (at the start of the reaction)	**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
6(b)(ii)	An answer that makes reference to the following point: • some of the carbon dioxide gas dissolves in water in the trough in Apparatus **1**	Allow reaction with water to form carbonic acid Ignore gas lost in water Ignore just reacts with water	**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
6(b)(iii)	An explanation that makes reference to the following points: **either** • usea gas syringe with smaller graduations / increment measures **(1)** • so the volume of gas can be read / measured to a greater degree of accuracy **(1)** **or** greater mass of XCO_3 • **(1)** which will produce a bigger volume and reduce the • percentage error **(1)**	Reason linked to improvement Allow precision for accuracy Alternative answer Saturate the solution with CO_2 by adding a **small** amount of a (soluble) carbonate / hydrogencarbonate so that all of the CO_2 produced goes directly into the gas syringe	**(2)**

Question Number	Answer	Mark
6(b)(iv)	**The only correct answer is B** ($Ar = (\frac{24\,000}{50}) \times 0.320 - 60$) ***A*** *is not correct because the 0.320 should be in the numerator, not the denominator* ***C*** *is not correct because this has the same errors as* ***A*** *and then 60 is added, not subtracted, for a second mistake* ***D*** *is not correct because this calculates the formula mass of XCO_3 and then 60 is added*	**(1)**

Question Number	Answer	Mark
6(b)(v)	**The only correct answer is C** (strontium) ***A*** *is not correct because Mg has an atomic mass less than the calculated value for X but is further from the value than Sr* ***B*** *is not correct because Ca has an atomic mass less than the calculated value for X but is further from the value than Sr* ***D*** *is not correct because Ba has an atomic mass larger than the mass calculated for X and is further from the value than Sr*	**(1)**

Question Number	Acceptable Answer		Additional Guidance	Mark
6(b)(vi)	An answer that makes reference to the following points:		TE throughout on Group 2 flame colours and justification with respect to the other metals in the list.	**(2)**
	• Red / Crimson	**(1)**		
	• whether this confirms the identification or not	**(1)**	Yes as red flame confirms the identity as calcium has a more brick-red flame / flame with a more orange colour or No it does not confirm the identity as calcium also has a red flame	

Question Number	Acceptable Answer	Additional Guidance	Mark
6(c)	An explanation that makes reference to the following points: • the carbonate may not fully react **(1)** • because some group 2 sulfates are insoluble forming abarrier/ layer on the surface **(1)**	Allow precipitate forms on the surface of the carbonate Ignore any reference to reaction rate	**(2)**

(Total for Question 6 = 12 marks)

<table>
<tr><th>Question Number</th><th>Acceptable Answer</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr>
<td>*7</td>
<td>
This question assesses a student’s ability to show a coherent and logically structured answer with linkages and fully sustained reasoning.

Marks are awarded forindicativecontent and for how the answer is structured and showslinesofreasoning.

The following tableshowshowthemarks should be awarded for indicative content.

<table>
<tr><td>Number of indicativemarking points seeninanswer</td><td>Number of marks awarded for indicative marking points</td></tr>
<tr><td>6</td><td>4</td></tr>
<tr><td>5–4</td><td>3</td></tr>
<tr><td>3–2</td><td>2</td></tr>
<tr><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td></tr>
</table>

The following tableshowshowthemarks should be awarded for structure and linesofreasoning.

<table>
<tr><td></td><td>Number of marks awarded for structure of answer and sustained line of reasoning</td></tr>
<tr><td>Answer showsacoherentand logical structurewithlinkagesand fully sustainedlinesofreasoning demonstrated throughout.</td><td>2</td></tr>
<tr><td>Answer is partiallystructuredwith some linkagesandlinesof reasoning.</td><td>1</td></tr>
<tr><td>Answer has nolinkagesbetween points andisunstructured.</td><td>0</td></tr>
</table>
</td>
<td>
Guidance on how the mark scheme should be applied:

The mark for indicative content should be added to the mark for lines of reasoning.

For example, an answer with five indicative marking points, which is partially structured with some linkages and lines of reasoning, scores 4 marks (3 marks for indicative content and 1 mark for partial structure and some linkages and lines of reasoning).

If there are no linkages between points, the same five indicative marking points would yield an overall score of 3 marks (3 marks for indicative content and no marks for linkages).

In general it would be expected that 5 or 6 indicative points would get 2 reasoning marks, and 3 or 4 indicative points would get 1 mark for reasoning, and 0, 1 or 2 indicative points would score zero marks for reasoning.

If there is any incorrect chemistry, deduct mark(s) from the reasoning. If no reasoning mark(s) awarded do not deduct mark(s).
</td>
<td>(6)</td>
</tr>
</table>

	Indicative content: **IP1** silicon hasavery high melting temperature so is a giant (covalent) structure **IP2** silicon is held together by (strong) **covalent** bonds which require a lot of energy to break (in order to melt silicon) **IP3** phosphorus, sulfur and chlorine have low melting temperatures as they are simple molecular structures / simple covalent structures **IP4** the molecules are held together by weak intermolecular forces (which require less energy to break than the bonds in silicon) **IP5** intermolecular forces are strongest in molecules with the greatest number of electrons **IP6** comparison of sulfur and chlorine with respect to the intermolecular forces between the molecules	Reject metallic or ionic bonding throughout Ignore macro molecular Do not award mention of intermolecular bonds or molecules in silicon. Ignore just covalent structures Accept held together by London dispersion forces / instantaneous-induced dipole forces Do not award permanent dipoles Accept larger molecules have greater surface area in contact thus larger intermolecular forces Accept sulfur has 8 atoms in its molecule, phosphorus has 4 and chlorine has 2, (S_8 P_4 and Cl_2) **and** comparison to intermolecular forces	

(Total for Question 7 = 6 marks)

Question Number	Acceptable Answer	Additional Guidance	Mark
8(a)	• calculation of moles of $BaCl_2$ **(1)** • calculation of energy change in the reaction **(1)** • calculation of temperature rise (this must be a positive number) **(1)**	Example of calculation $\div 208.3 = 0.038406 / 3.8406 \times 10^{-2}$ $0.038406 \times 32000 = 1229.0$ (J) Ignore sign $T = 1229.0 \div (50.0 \times 4.18) = 5.8804 / 5.88 / 5.9$ (ºC) Ignore SF except 1 SF Correct answer with or without working scores (3) Allow early correct rounding Allow K for ºC	**(3)**

Question Number	Acceptable Answer	Additional Guidance	Mark
8(b)(i)	• (enthalpy change for □$H1$) is lattice energy (of formation) of $BaCl_2$ **(1)** • (enthalpy change for □H_4) is enthalpy change of hydration of Cl^- **(1)**		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
8(b)(ii)	• gives expression for 2 H_4 **(1)** • calculation of value for □H_4 **(1)**	Example of calculation $H_4 = H_1 + H_3 - H_2$ Or □□H_4 = −□□□□ + −□□ − −□□□□ $H_4 = -728 \div 2 = -364$ (kJ mol^{-1}) Correct value scores 2 No TE on incorrect expression	**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
8(c)(i)	• because it is a solid / heterogeneous **and** so concentration is ignored	Accept the concentration of a solid is constant	**(1)**

Question Number	Acceptable Answer	Additional Guidance	Mark
8(c)(ii)	• calculation of concentration	Example of calculation concentration = moles ÷ volume concentration = $\frac{0.270 \div 136.2}{0.1}$ = 1.9824×10^{-2} / 0.019824 (mol dm^{-3}) Ignore SF	**(1)**

Question Number	Acceptable Answer		Additional Guidance	Mark
8(c)(iii)	• calculation of K_{c1} • units	**(1)** **(1)**	Example of calculation $K_{c1} = (1.9824 \times 10^{-2})^2$ $= 3.9298 \times 10^{-4}$ $mol^2\ dm^{-6}$ Ignore SF Allow TE from 8(c)(ii)	**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
8(d)(i)	• calculation of RHS of equation **(1)** • rearrangement of equation to make $\log_{10}K_{c2}$ the subject of the equation **(1)** • calculation of $\log_{10}K_{c1}$ **(1)** • evaluation of K_{c2} **(1)**	Example of calculation $\Delta_{sol}H \times 2.61 \times 10^{-5} = -0.46458$ $\log_{10}K_{c2} = \log_{10}K_{c1} - 0.46458$ $\log_{10}K_{c1} = \log_{10}(\text{ans(c)(iii)}) = -3.4056$ $K_{c2} = 10^{-3.4056 - 0.46458} = 1.3483 \times 10^{-4}$ Correct answer scores 4 Ignore units Use of $K_{c1} = 6.50 \times 10^{-6}$ gives values of $\log_{10}K_{c1} = -5.1871$ $K_{c2} = 10^{-5.1871 - 0.46458} = 2.2301 \times 10^{-6}$ Use of provided K_{c1} as above scores 4 A TE value of 4×10^{-4} from c(iii) gives a K_{c2} value of 1.37×10^{-4} scores 4	**(4)**

Question Number	Acceptable Answer	Additional Guidance	Mark
8(d)(ii)	An answer that makes reference to the following points: • explanation in terms of the K_c values the effect on the equilibrium/ ion concentration **(1)** • how solubility changes with temperature **(1)**	M2 dependent on M1 At 350 K, K_c is lower than at 298 K so equilibrium is moved to the left Increasing temperature decreases solubility Correct linkage between the enthalpy of solution given in d, the drop in the Kc value and the resulting solubility decrease 2 marks	**(2)**

(Total for Question 8 = 17 marks)
TOTAL FOR PAPER = 90 MARKS

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