AS
CHEMISTRY
7404/1

Paper 1 Inorganic and Physical Chemistry

Mark scheme

June 2024

Version: 1.0 Final

2 4 6 A 7 4 0 4 / 1 / M S

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

No student should be disadvantaged on the basis of their gender identity and/or how they refer to the gender identity of others in their exam responses.

A consistent use of 'they/them' as a singular and pronouns beyond 'she/her' or 'he/him' will be credited in exam responses in line with existing mark scheme criteria.

Further copies of this mark scheme are available from aqa.org.uk

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AS and A-Level Chemistry
Mark Scheme Instructions for Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information in the 'Comments' column is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

You should mark according to the contents of the mark scheme. If you are in any doubt about applying the mark scheme to a particular response, consult your Team Leader.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which might confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

The use of M1, M2, M3 etc in the right-hand column refers to the marking points in the order in which they appear in the mark scheme. So, M1 refers to the first marking point, M2 the second marking point etc.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **OR**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general 'List' principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (often prefaced by 'Ignore' in the mark scheme) are not penalised.

For example, in a question requiring 2 answers for 2 marks:

Correct answers	Incorrect answers (ie incorrect rather than neutral)	Mark (2)	Comment
1	0	1	
1	1	1	They have not exceeded the maximum number of responses so there is no penalty.
1	2	0	They have exceeded the maximum number of responses so the extra incorrect response cancels the correct one.
2	0	2	
2	1	1	
2	2	0	
3	0	2	The maximum mark is 2
3	1	1	The incorrect response cancels out one of the two correct responses that gained credit.
3	2	0	Two incorrect responses cancel out the two marks gained.
3	3	0	

3.2 Marking procedure for calculations

Full marks should be awarded for a correct numerical answer, without any working shown, unless the question states 'Show your working' or 'justify your answer'. In this case, the mark scheme will clearly indicate what is required to gain full credit.

If an answer to a calculation is incorrect and working is shown, process mark(s) can usually be gained by correct substitution / working and this is shown in the 'Comments' column or by each stage of a longer calculation.

3.3 Errors carried forward, consequential marking and arithmetic errors

Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation ECF or consequential in the marking scheme.

An arithmetic error should be penalised for one mark only unless otherwise amplified in the marking scheme. Arithmetic errors may arise from a slip in a calculation or from an incorrect transfer of a numerical value from data given in a question.

3.4 Equations

In questions requiring students to write equations, state symbols are generally ignored unless otherwise stated in the 'Comments' column.

Examiners should also credit correct equations using multiples and fractions unless otherwise stated in the 'Comments' column.

3.5 Oxidation states

In general, the sign for an oxidation state will be assumed to be positive unless specifically shown to be negative.

3.6 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.7 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term or if the question requires correct IUPAC nomenclature.

3.8 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.9 Ignore / Insufficient / Do <u>not</u> allow

Ignore or insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

3.10 Marking crossed out work

Crossed out work that **has not been** replaced should be marked as if it were not crossed out, if possible. Where crossed out work **has been** replaced, the replacement work and not the crossed out work should be marked.

3.11 Reagents

The command word "Identify", allows the student to choose to use **either** the name or the formula of a reagent in their answer. In some circumstances, the list principle may apply when both the name and the formula are used. Specific details will be given in mark schemes.

The guiding principle is that a reagent is a chemical which can be taken out of a bottle or container. Failure to identify complete reagents **will be penalised**, but follow-on marks (eg for a subsequent equation or observation) can be scored from an incorrect attempt (possibly an incomplete reagent) at the correct reagent. Specific details will be given in mark schemes.

For example, **no credit** would be given for

- the cyanide ion or CN^- when the reagent should be potassium cyanide or KCN;
- the hydroxide ion or OH^- when the reagent should be sodium hydroxide or NaOH;

- the $Ag(NH_3)_2^+$ ion when the reagent should be Tollens' reagent (or ammoniacal silver nitrate). In this example, no credit is given for the ion, but credit could be given for a correct observation following on from the use of the ion. Specific details will be given in mark schemes.

In the event that a student provides, for example, **both** KCN and cyanide ion, it would be usual to ignore the reference to the cyanide ion (because this is not contradictory) and credit the KCN. Specific details will be given in mark schemes.

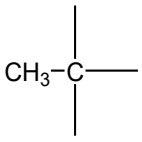
3.12 Organic structures

Where students are asked to draw organic structures, unless a specific type is required in the question and stated in the mark scheme, these may be given as displayed, structural or skeletal formulas or a combination of all three as long as the result is unambiguous.

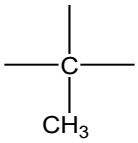
In general

- Displayed formulae must show all of the bonds and all of the atoms in the molecule, but need not show correct bond angles.
- Skeletal formulae must show carbon atoms by an angle or suitable intersection in the skeleton chain. Functional groups must be shown and it is essential that all atoms other than C atoms are shown in these (except H atoms in the functional groups of aldehydes, secondary amines and N-substituted amides which do not need to be shown).
- Structures must not be ambiguous, eg 1-bromopropane should be shown as $CH_3CH_2CH_2Br$ and not as the molecular formula C_3H_7Br which could also represent the isomeric 2-bromopropane.
- Bonds should be drawn correctly between the relevant atoms. This principle applies in all cases where the attached functional group contains a carbon atom, eg nitrile, carboxylic acid, aldehyde and acid chloride. The carbon-carbon bond should be clearly shown. Wrongly bonded atoms will be penalised **on every occasion**. (see the examples below)
- The same principle should also be applied to the structure of alcohols. For example, if students show the alcohol functional group as C ─ HO, they should be penalised **on every occasion**.
- Latitude should be given to the representation of C ─ C bonds in alkyl groups, given that CH_3─ is considered to be interchangeable with H_3C─ even though the latter would be preferred.
- Similar latitude should be given to the representation of amines where NH_2─ C will be allowed, although H_2N─ C would be preferred.
- Poor presentation of vertical C ─ CH_3 bonds or vertical C ─ NH_2 bonds should **not** be penalised. For other functional groups, such as ─ OH and ─ CN, the limit of tolerance is the half-way position between the vertical bond and the relevant atoms in the attached group.

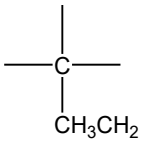
By way of illustration, the following would apply.



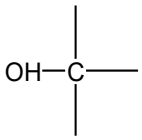
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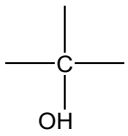
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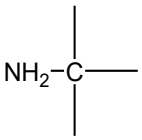
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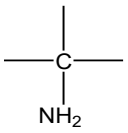
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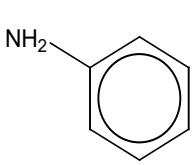
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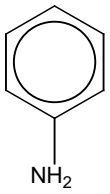
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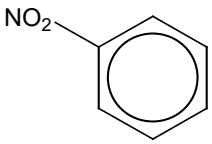
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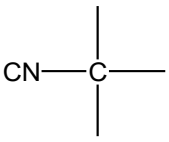
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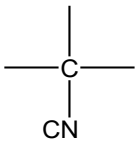
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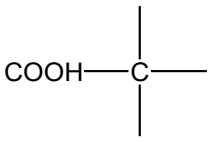
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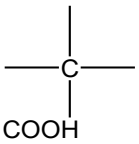
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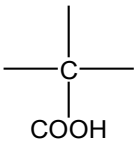
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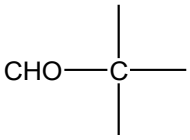
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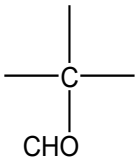
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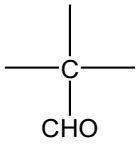
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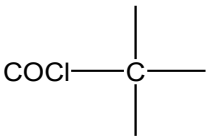
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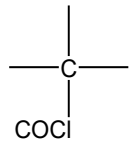
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- Representation of CH_2 by $C–H_2$ will be penalised
- Some examples are given here of **structures** for specific compounds that should **not** gain credit (but, exceptions <u>may</u> be made in the context of balancing equations)

CH_3COH	for	ethanal
CH_3CH_2HO	for	ethanol
$OHCH_2CH_3$	for	ethanol
C_2H_6O	for	ethanol
CH_2CH_2	for	ethene
$CH_2.CH_2$	for	ethene
$CH_2:CH_2$	for	ethene

- Each of the following **should gain credit** as alternatives to correct representations of the structures.

$CH_2 = CH_2$	for	ethene, $H_2C=CH_2$
$CH_3CHOHCH_3$	for	propan-2-ol, $CH_3CH(OH)CH_3$

- In most cases, the use of "sticks" to represent C ─ H bonds in a structure should **not** be penalised. The exceptions to this when "sticks" will be penalised include:
    - structures in mechanisms where the C ─ H bond is essential (eg elimination reactions in halogenoalkanes and alcohols)
    - when a displayed formula is required
    - when a skeletal structure is required or has been drawn by the candidate.

3.13 Organic names

As a general principle, non-IUPAC names or incorrect spelling or incomplete names should **not** gain credit. Some illustrations are given here.

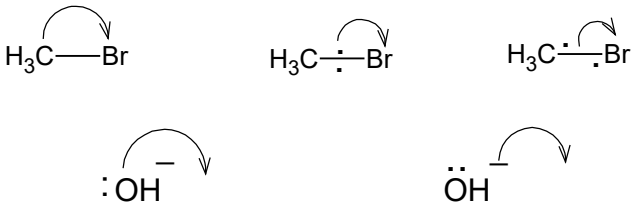
Unnecessary but not wrong numbers will **not** be penalised such as the number '2' in 2-methylpropane or the number '1' in 2-chlorobutan-1-oic acid.

but-2-ol	should be **butan-2-ol**
2-hydroxybutane	should be **butan-2-ol**
butane-2-ol	should be **butan-2-ol**
2-butanol	should be **butan-2-ol**
ethan-1,2-diol	should be **ethane-1,2-diol**
2-methpropan-2-ol	should be **2-methylpropan-2-ol**
2-methylbutan-3-ol	should be **3-methylbutan-2-ol**
3-methylpentan	should be **3-methylpentane**
3-mythylpentane	should be **3-methylpentane**
3-methypentane	should be **3-methylpentane**
propanitrile	should be **propanenitrile**
aminethane	should be **ethylamine** (although aminoethane can gain credit)
2-methyl-3-bromobutane	should be **2-bromo-3-methylbutane**
3-bromo-2-methylbutane	should be **2-bromo-3-methylbutane**
3-methyl-2-bromobutane	should be **2-bromo-3-methylbutane**
2-methylbut-3-ene	should be **3-methylbut-1-ene**
difluorodichloromethane	should be **dichlorodifluoromethane**

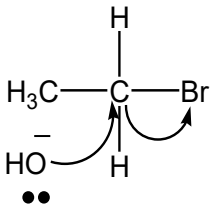
3.14 Organic reaction mechanisms

Curly arrows should originate either from a lone pair of electrons or from a bond.

The following representations should not gain credit **and will be penalised each time** within a clip.



For example, the following would score zero marks



When the curly arrow is showing the formation of a bond to an atom, the arrow can go directly to the relevant atom, alongside the relevant atom or **more than half-way** towards the relevant atom.

In free-radical substitution:

- the absence of a radical dot should be penalised **once only** within a clip.
- the use of half-headed arrows is not required, but the use of double-headed arrows or the incorrect use of half-headed arrows in free-radical mechanisms should be penalised **once only** within a clip.

The correct use of skeletal formulae in mechanisms is acceptable, but where a C-H bond breaks, both the bond and the H must be drawn to gain credit.

3.15 Extended responses

For questions marked using a 'Levels of Response' mark scheme:

Level of response mark schemes are broken down into three levels, each of which has a descriptor. Each descriptor contains two statements. The first statement is the Chemistry content statement and the second statement is the communication statement.

Determining a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the Chemistry content descriptor for that level. The descriptor for the level indicates the qualities that might be seen in the student's answer for that level. If it meets the lowest level, then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level.

Once the level has been decided, the mark within the level is determined by the communication statement:

- If the answer completely matches the communication descriptor, award the higher mark within the level.
- If the answer does not completely match the communication descriptor, award the lower mark within the level.

The exemplar materials used during standardisation will help you to determine the appropriate level. There will be an exemplar in the standardising materials which will correspond with each level of the mark scheme and for each mark within each level. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the exemplar to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the exemplar.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other chemically valid points. Students may not have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme. The mark scheme will state how much chemical content is required for the highest level.

An answer which contains nothing of relevance to the question must be awarded no marks.

For other extended response answers:

Where a mark scheme includes linkage words (such as 'therefore', 'so', 'because' etc), these are optional. However, a student's marks for the question may be limited if they do not demonstrate the ability to construct and develop a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. In particular answers in the form of bullet pointed lists may not be awarded full marks if there is no indication of logical flow between each point or if points are in an illogical order.

The mark schemes for some questions state that the maximum mark available for an extended response answer is limited if the answer is not coherent, relevant, substantiated and logically structured. During the standardisation process, the Lead Examiner will provide marked exemplar material to demonstrate answers which have not met these criteria. You should use these exemplars as a comparison when marking student answers.

Question	Marking guidance	Additional Comments/Guidelines	Mark
01.1	Iodide ion / I^- $Br_2 + 2I^- \rightarrow I_2 + 2Br^-$	not iodine / I / I_2 allow: $Br_2 + 3I^- \rightarrow I_3^- + 2Br^-$ ignore state symbols; accept multiples	2 (2 x AO3)

Question	Marking guidance	Additional Comments/Guidelines	Mark
01.2	Bromine not a strong enough oxidising agent to displace chlorine (so no visible change will be observed) Bromine not a strong enough oxidising agent to displace bromine (so no visible change will be observed)	Br_2 unable to oxidise Cl^- (so no visible change will be observed.) Br_2 is a weaker oxidising agent than Cl_2 / Br_2 is only a stronger oxidising agent than I_2 Br_2 is unable to oxidise Br^- (so no visible change will be observed) allow Br_2 has the same oxidising ability as itself do not allow references to halides having oxidising ability do not allow bromine reacting with halogens	2 (2 x AO3)

Question	Marking guidance	Additional Comments/Guidelines	Mark
01.3	Add <u>dilute</u> ammonia The precipitate containing chloride ions will dissolve/react to form a colourless solution The precipitate containing bromide ions will show no visible change OR Add dilute ammonia <u>followed</u> by concentrated ammonia The precipitate containing chloride ions will dissolve/react to form a colourless solution using dilute ammonia The precipitate containing bromide ions will not dissolve in dilute ammonia but will dissolve in concentrated ammonia.	allow ecf from question 01.1 allow does not dissolve ignore references to precipitates containing iodide ions unless due to ecf from Qu 01.1	3 (3 x AO3)

Question	Marking guidance	Additional Comments/Guidelines	Mark
02.1	Electron is removed from 1(s) (rather than 2(s)) Lower in energy (than 2s) / Less/No shielding / closer to the nucleus Stronger attraction between nucleus and <u>outer</u> electron	Mark independently	3 (3 x AO2)

Question	Marking guidance	Additional Comments/Guidelines	Mark
02.2	Similarity: produce hydrogen / produce gas / produce white solids / produce Mg^{2+} compounds / produce a base Difference: magnesium oxide formed with steam and magnesium hydroxide formed with (cold) water		2 (2 x AO1)

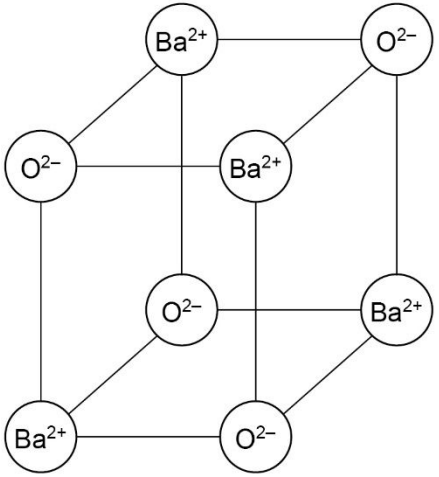
Question	Marking guidance	Additional Comments/Guidelines	Mark
02.3	Oxidation state of Ca increases, so Ca is oxidised OR Oxidation state of Ca from 0 to +2, so Ca is oxidised Oxidation state of H decreases, so H is reduced OR Oxidation state of H from +1 to 0, so H is reduced	If no marks awarded, then correct oxidation states of Ca **and** H before **and** after the reaction scores 1 mark	2 (2 x AO2)

Question	Marking guidance	Additional Comments/Guidelines	Mark
03.1	The (relative) ability of an atom to attract electron density in a covalent bond OR the (relative) ability of an atom to attract the pair of electrons in a covalent bond.		1 (1 x AO1)

Question	Marking guidance	Additional Comments/Guidelines	Mark
03.2	Chlorine has a higher electronegativity (than carbon) OR Carbon has a lower electronegativity (than chlorine) So the electron density is unsymmetrical / so chlorine becomes δ– and carbon becomes δ+	allow carbon and chlorine have different electronegativities	2 (2 x AO2)

Question	Marking guidance	Additional Comments/Guidelines	Mark
03.3	CCl_4 is (a) symmetrical (molecule) / is tetrahedral / there is an even distribution of electron density So the dipoles cancel out	Ignore no dipole moment Do not allow the polar bonds cancel out / partial charges cancel	2 (2 x AO2)

Question	Marking guidance	Additional Comments/Guidelines	Mark
03.4	(Random) movement of electrons (in one molecule creates a dipole) / a temporary dipole is formed (in one molecule) / an imbalance in electron density (in one molecule) Induces a dipole in another molecule (These temporary) dipoles in different molecules attract / (temporary) attraction between δ+ and δ– in different molecules	Allow M3 from a diagram	3 (3 x AO1)

Question	Marking guidance	Additional Comments/Guidelines	Mark
03.5	Alternating ions with correct charges on ions Cubic 3D arrangement with minimum of 8 particles Diagram 		2 (2 x AO2)

<table>
<tr><th>Question</th><th>Marking guidance</th><th>Additional Comments/Guidelines</th><th>Mark</th></tr>
<tr>
<td>04</td>
<td>This question is marked using levels of response. Refer to the Mark Scheme Instructions for Examiners for guidance on how to mark this question.
<table>
<tr><td>Level 3:
All stages are covered and the explanation of each stage is generally correct and virtually complete.
Answer is well structured with no repetition or irrelevant points.
Accurate and clear expression of ideas with no errors in use of technical terms.</td><td>5-6</td></tr>
<tr><td>Level 2:
All stages are covered but the explanation of each stage may be incomplete or may contain inaccuracies OR two stages are covered and the explanations are generally correct <u>and</u> virtually complete.
Answer shows some attempt at structure.
Ideas are expressed with reasonable clarity with, perhaps, some repetition or some irrelevant points.
Some minor errors in use of technical terms.</td><td>3-4</td></tr>
</table>
</td>
<td>In order to score 6 marks all 4 compounds must be identified in some way

Stage 1: Suggested tests (3 + virtually 'complete', 1 + 'covered')

1a: add NaOH
1b: add NaOH (and warm) then hold damp red litmus at mouth of tube (if sequential tests performed NaOH can be scored from 1a)
1c: add nitric acid / hydrochloric acid
1d: add acidified $BaCl_2$ / acidified $Ba(NO_3)_2$
(if sequential tests performed acidified can be scored from 1c)

Stage 2: Observations linked to correct solution and test (3 + virtually 'complete', 1 + 'covered')

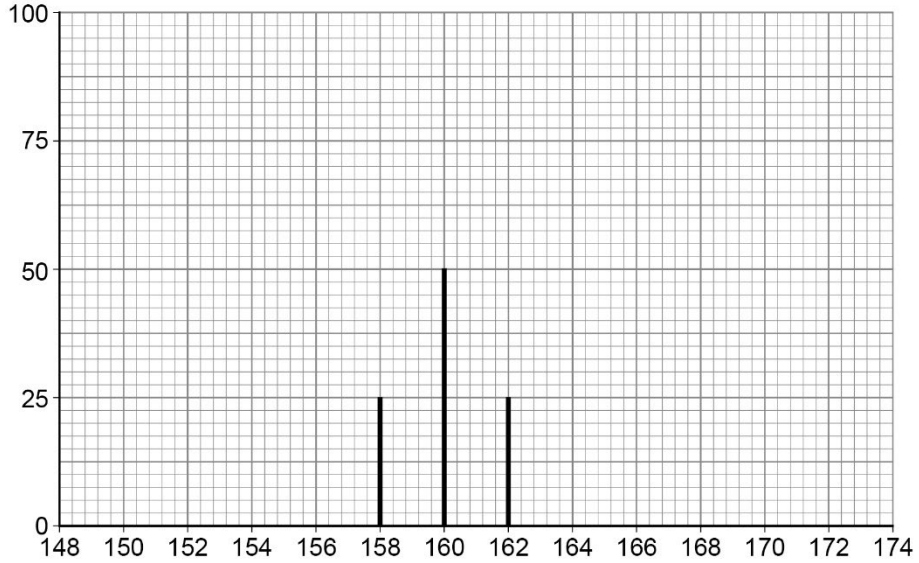
2a: Mg^{2+}/$Mg(NO_3)_2$ will give a white ppt with NaOH
2b: red litmus (at mouth of the tube) will turn blue for NH_4^+/NH_4NO_3 with NaOH
(do not award if red litmus is placed in the solution)
2c: CO_3^{2-}/Na_2CO_3 will effervesce with acid / gas formed turns limewater cloudy
2d: SO_4^{2-}/K_2SO_4 will give a white ppt with $BaCl_2$
2e: the final tube will be the remaining solution (if only three tests have been done).</td>
<td>6
(4 x AO3, 2 x AO2)</td>
</tr>
</table>

04 (cont)	**Level 1:** Two stages are covered but the explanation of each stage may be incomplete or may contain inaccuracies, OR only one stage is covered but the explanation is generally correct and virtually complete. Answer includes isolated statements but these are not presented in a logical order or show some confusion. Answer may contain valid points which are not clearly linked to an argument structure. Errors in the use of technical terms.	1-2	Stage 3: Equations **(3 + virtually 'complete', 1 + 'covered')** 3a: $Mg^{2+} + 2\,OH^- \rightarrow Mg(OH)_2$ 3b: $NH_4^+ + OH^- \rightarrow NH_3 + H_2O$ 3c: $CO_3^{2-} + 2\,H^+ \rightarrow CO_2 + H_2O$ 3d: $SO_4^{2-} + Ba^{2+} \rightarrow BaSO_4$ (ignore state symbols; allow multiples)	
	Level 0 Insufficient correct chemistry to gain a mark.	0		

Question	Marking guidance	Additional Comments/Guidelines	Mark
05	M1: SF_6 is octahedral (either in words or as a structure) M2: SF_6 bond angle is 90° M3: SF_6 all the bond pairs repel equally M4: SF_3^+ is (trigonal) pyramidal (either in words or as a structure) M5: SF_3^+ bond angle is 103-107° M6: SF_3^+ lone pair-bond pair repulsion is greater than bond pair-bond pair repulsion (so bond angle is reduced)	(allow tetrahedral)	6 (6 x AO1)

Question	Marking guidance	Additional Comments/Guidelines	Mark
06.1	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^5$	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^5$	1 (1 x AO1)

Question	Marking guidance	Additional Comments/Guidelines	Mark
06.2	$Br_2(g) \rightarrow Br_2^+(g) + e^-$ OR $Br_2(g) + e^- \rightarrow Br_2^+(g) + 2e^-$	Do not penalise the inclusion of a radical dot	1 (1 x AO1)

Question	Marking guidance	Additional Comments/Guidelines	Mark
06.3	 M1: both axes labelled y-axis = (relative) abundance **or** % x-axis = m/z M2: two additional peaks at m/z = 160 and 162 M3: peaks at 158,160 and 162 in the relative heights 1:2:1		3 (3 x AO2)

Question	Marking guidance	Additional Comments/Guidelines	Mark
06.4	The (relative) abundance is proportional to the size of the current.		1 (1 x AO1)

Question	Marking guidance	Additional Comments/Guidelines	Mark
07.1	% uncertainty = (2 × 0.005 / 2.14) × 100 = 0.467%	2 sf or more	1 (1 x AO1)

Question	Marking guidance	Additional Comments/Guidelines	Mark
07.2	Moles = $25.0 \times 10^{-3} \times 2.00$ = <u>0.0500</u> mol	Answer must be to 3 sf	1 (1 x AO2)

Question	Marking guidance	Additional Comments/Guidelines	Mark
07.3	M1: n(NaOH used in titration) = 0.0900 × 0.02038 = 0.0018342 (mol) n(HCl in excess in 25cm^3) = 0.0018342 (mol) M2: n(HCl in excess in 250cm^3) = 0.0018342 × 10 = 0.018342 (mol) M3: n(HCl that reacted) = 0.0500 - 0.018342 = 0.031658 (mol) M4: n(MgO in 6 tablets using equation stoichiometry) = 0.031658/2 = 0.015829 (mol) M5: Mass of MgO in 6 tablets = 0.015829 × 40.3 = 0.6379 g M6: % by Mass of MgO = (0.6379 / 2.14) × 100= 29.8 %	M1: Moles NaOH M2: M1 × 10 M3: Q07.2 - M2 M4: M3/2 M5: M4 × 40.3 M6: (M5 / 2.14) ×100	6 (6 x AO2)

Question	Marking guidance	Additional Comments/Guidelines	Mark
08.1	The enthalpy change when one mole of a substance is formed from its (constituent) elements. All substances in their standard states (at 100 kPa and a stated temperature).	allow heat energy change	2 (2 x AO1)

Question	Marking guidance	Additional Comments/Guidelines	Mark
08.2	($\Delta H = \Sigma\Delta_f H$(products) – $\Sigma\Delta_f H$(reactants)) M1: +56.2 = (–123+90.4) – 2x 2x = –88.8 kJ mol^{-1} M2: x = –44(.4) kJmol^{-1}	 M2 = their M1/2	2 (2 x AO2)

Question	Marking guidance	Additional Comments/Guidelines	Mark
08.3	The silver nitrate has to be heated so you cannot measure the temperature change caused by the reaction.	difficult to measure the temperature (change) of solids / $AgNO_3$ may decompose / silver nitrate(V) may decompose / other oxides of nitrogen would be formed	1 (1 x AO2)

Question	Marking guidance	Additional Comments/Guidelines	Mark
08.4	Any three of these - improvements must **match** the identified inaccuracies. Inaccuracy 1 - Use of a glass beaker. Improvement 1 - Use a polystyrene cup or use insulation (to reduce heat loss.) Inaccuracy 2 - Did not record the initial temperature. Improvement 2 - Record an initial starting temperature before adding the solid sodium chloride / Recording the starting temperature of the silver nitrate solution Inaccuracy 3: Used low concentration of silver nitrate. Improvement 3: Use a higher concentration of silver nitrate (so that the temperature change is larger) Inaccuracy 4: Does not take into account heat loss / method to determine maximum temperature not effective Improvement 4: Measure the temperature at suitable time intervals after the addition, plot a graph and extrapolate to determine the maximum change. Inaccuracy 5: Does not take into account the enthalpy change when the excess NaCl dissolves. Improvement 5: Calculates the effect of the excess NaCl dissolving.	Allow Inaccuracy 6 – uses a measuring cylinder Improvement 6 – use a burette/volumetric pipette instead	6 (6 x AO3)

Question	Marking guidance	Additional Comments/Guidelines	Mark
09.1	An electron acceptor	Do not accept electron pair acceptor or gain of electrons	1 (1 x AO1)

Question	Marking guidance	Additional Comments/Guidelines	Mark
09.2	$Cu \rightarrow Cu^{2+} + 2e^-$	Ignore state symbols, even if incorrect. Accept multiples	1 (1 x AO2)

Question	Marking guidance	Additional Comments/Guidelines	Mark
09.3	$NO_3^- + 2H^+ + e^- \rightarrow NO_2 + H_2O$	Ignore state symbols, even if incorrect. Accept multiples	1 (1 x AO2)

Question	Marking guidance	Additional Comments/Guidelines	Mark
09.4	$Cu + 2NO_3^- + 4H^+ \rightarrow Cu^{2+} + 2NO_2 + 2H_2O$	Ignore state symbols, even if incorrect. Accept multiples	1 (1 x AO2)

Question	Marking Guidance	Mark	Comments
10	**D**	1 (AO2)	73.3%
11	**D**	1 (AO1)	$BH_3 + H^- \rightarrow BH_4^-$
12	**A**	1 (AO2)	25.95 cm^3
13	**C**	1 (AO1)	Hydrogen
14	**A**	1 (AO1)	Calcium oxide is used to remove sulfur dioxide from flue gases.
15	**C**	1 (AO2)	K
16	**A**	1 (AO1)	A
17	**C**	1 (AO1)	C
18	**B**	1 (AO1)	ClO_3
19	**C**	1 (AO3)	NaCl
20	**D**	1 (AO1)	A sample of CO_2 that is ionised using electron impact ionisation
21	**C**	1 (AO2)	$\frac{117}{50}Sn$

22	**C**	1 (AO2)	$Mg^{+}(g) \longrightarrow Mg^{2+}(g) + e^{-}$
23	**B**	1 (AO2)	Rinsing the sides of the conical flask with water
24	**C**	1 (AO1)	Fe