آغا خان یونیورسٹی ایگزامینیشن بورڈ
AGA KHAN UNIVERSITY EXAMINATION BOARD

Notes from E-Marking Centre on SSC-I Chemistry Annual Examinations 2025

Introduction

This document has been produced for the teachers and candidates of Secondary School Certificate (SSC) Part I Chemistry. It contains comments on candidates' responses to the 2025 SSC-I Examination indicating the quality of the responses and highlighting their relative strengths and weaknesses.

E-Marking Notes

This includes overall comments on candidates' performance on every question and *some* specific examples of candidates' responses that support the mentioned comments. Please note that the descriptive comments represent an overall perception of the better and weaker responses as gathered from the e-marking session. However, the candidates' responses shared in this document represent some specific example(s) of the mentioned comments.

Teachers and candidates should be aware that examiners may ask questions that address the Student Learning Outcomes (SLOs) in a manner that requires candidates to respond by integrating knowledge, understanding and application skills they have developed during the course of study. Candidates are advised to read and comprehend each question carefully before writing the response to fulfil the demand of the question.

Candidates need to be aware that the marks allocated to the questions are related to the answer space provided on the examination paper as a guide to the length of the required response. A longer response will not in itself lead to higher marks. Candidates need to be familiar with the command words in the SLOs which contain terms commonly used in examination questions. However, candidates should also be aware that not all questions will start with or contain one of the command words. Words such as 'how', 'why' or 'what' may also be used. It is imperative to refer to command word guide available on AKU-EB website for understanding the expectations of the command word.

General Observations

Candidates generally demonstrated a satisfactory understanding of core chemistry concepts, particularly in areas such as chemical bonding, writing correct chemical equations for different reactions, separation techniques, and recognising the structural features of voltaic cells. Better responses reflected clarity in scientific reasoning, appropriate use of terminology, and structured explanations aligned with the question requirements. However, a significant proportion of weaker responses revealed persistent misconceptions, surface-level understanding, and difficulty applying concepts across different contexts. Many candidates struggled to interpret multi-part questions holistically and to articulate logical, stepwise explanations. These should be the focus of instructional improvement to enhance candidate performance in future assessments:

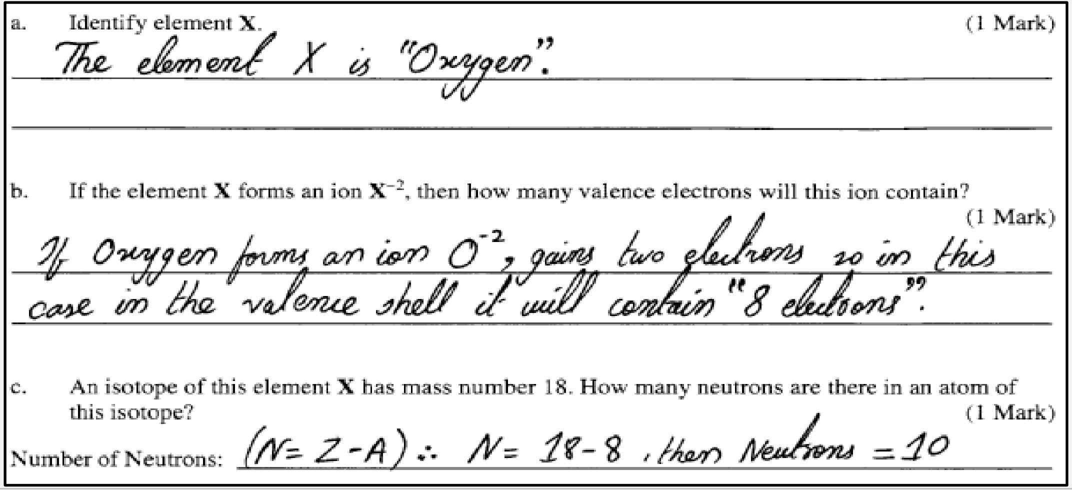
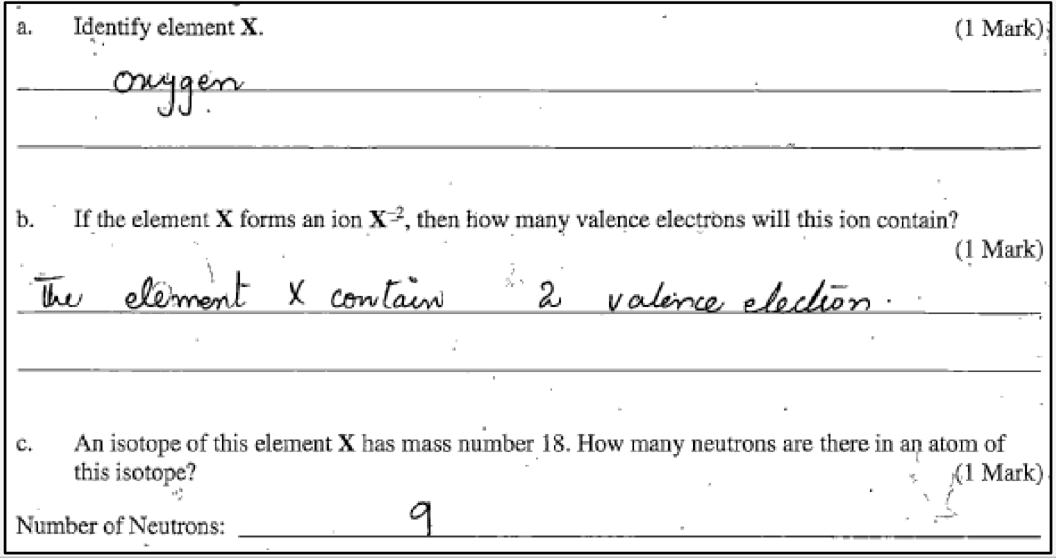
- Clarify distinctions between similar terms such as valence electrons, total electrons, and isotopes
- Reinforce core chemical principles (e.g., ion formation, types of bonding, and redox processes)
- Integrate real-life or practical scenarios to deepen conceptual understanding and application
- Guide candidates to construct logically ordered, stepwise responses with clear cause-and-effect reasoning, using correct scientific terminology and symbols
- Provide more opportunities to label, annotate, and interpret scientific diagrams (e.g., dot-and-cross structures, galvanic cells)
- Use diagnostic questions and feedback loops to address common misconceptions (e.g., filtration vs. crystallisation, coordinate vs. covalent bonds)
- Employ formative assessments to evaluate understanding before progressing to new content
- Incorporate regular past paper practice with guided feedback to improve examination technique

Note: Candidates' responses shown in this report have not been corrected for grammar, spelling, format, or information.

DETAILED COMMENTS

Constructed Response Questions (CRQs)

Question No. 1	
Question Text	The atom of an element **X** has 8 neutrons, 8 protons and 8 electrons. a. Identify element **X**. b. If the element **X** forms an ion $\mathbf{X}^{-2}$, then how many valence electrons will this ion contain? c. An isotope of this element **X** has mass number 18. How many neutrons are there in an atom of this isotope?
SLO No.	2.1.2
SLO Text	Calculate the mass (nucleon) number, number of electrons, protons and neutrons of atoms and ions;
Max Marks	3
Cognitive Level	A*
Checking Hints	a. 1 mark for the correct identification of element **X** b. 1 mark for the correct number of valence electrons in $\mathbf{X}^{-2}$ c. 1 mark for the correct number of neutrons in the given isotope
Overall Performance	Overall, candidates showed good performance on this question. A considerable number demonstrated commendable analytical thinking by correctly identifying the element using the atomic number, applying the octet rule, and accurately calculating the number of neutrons in an isotope. However, a noticeable group showed only surface-level comprehension. They struggled to apply the concept of achieving noble gas configuration through ion formation and failed to recognise that gaining two electrons completes the octet in oxygen. Common misconceptions included confusing electron gain with valence electron count, misidentifying the element by overlooking the proton number, and mistaking the mass number for the number of neutrons. These issues highlight underlying gaps in understanding atomic structure, ion formation, and isotope composition.
Description of Better Responses	*Better responses* demonstrated stronger conceptual understanding, as candidates exhibited a structured and accurate approach to all parts of the question. In part (a), they correctly identified element X as oxygen by linking the atomic number (8 protons) to its position in the periodic table. Their ability to connect proton number with elemental identity reflected solid foundational knowledge of atomic structure. In part (b), candidates accurately

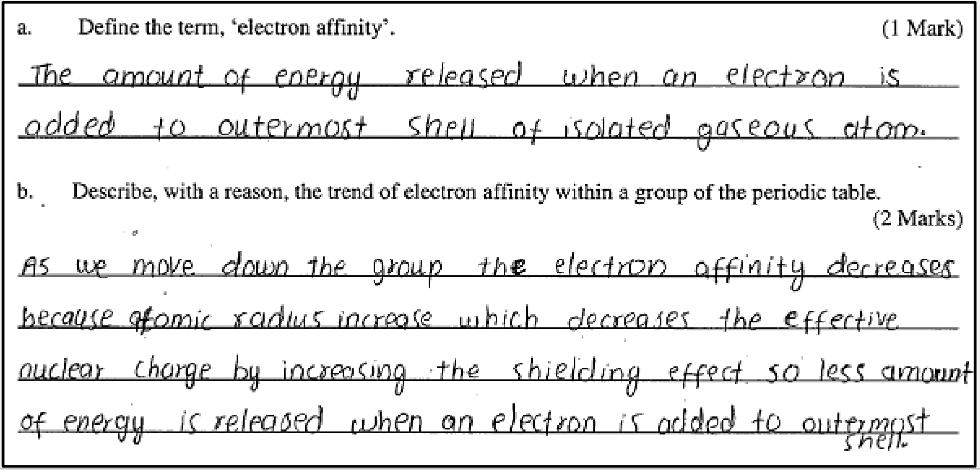
	determined that the X^{2-} ion contains 8 valence electrons by applying the concept of electron gain in non-metals. They recognised that a neutral oxygen atom has 6 valence electrons, and gaining two electrons completes its octet—demonstrating both conceptual clarity and effective application of the octet rule and ion formation. In part (c), better responses correctly calculated the number of neutrons in the isotope using the formula: mass number (18) minus atomic number (8), resulting in 10 neutrons. These answers often included an explanation of how isotopes differ in mass number, further reinforcing their understanding of atomic structure and isotopic variation.
Image of Better Response	 a. Identify element **X**. (1 Mark) The element X is "Oxygen". b. If the element **X** forms an ion $\mathbf{X}^{-2}$, then how many valence electrons will this ion contain? (1 Mark) If Oxygen forms an ion O^{-2}, gains two electrons so in this case in the valence shell it will contain "8 electrons". c. An isotope of this element **X** has mass number 18. How many neutrons are there in an atom of this isotope? (1 Mark) Number of Neutrons: $(N= Z-A) \therefore N= 18-8$, then Neutrons $=10$
Description of Weaker Responses	*Weaker responses* revealed several conceptual misunderstandings and a lack of clarity in interpreting atomic structure and related concepts. In part (a), a significant number of candidates were unable to identify the element using the number of protons, indicating a gap in understanding that the atomic number—equal to the number of protons—uniquely defines an element. In part (b), many candidates displayed confusion about ion formation and valence electrons. A common error was stating that the X^{2-} ion has only two valence electrons, reflecting a misunderstanding that confused the number of electrons gained with the total number of valence electrons in the resulting ion. Others incorrectly gave six valence electrons, assuming a –2 charge meant subtracting electrons rather than adding them. These responses revealed a fundamental misconception about how charge influences electron configuration. Additionally, weaker responses often failed to distinguish between valence electrons and the total number of electrons, indicating a surface-level grasp of electron distribution in atoms and ions. In part (c), several candidates misinterpreted the isotope question, providing the mass number as the neutron count rather than applying the correct formula (mass number – atomic number). This highlighted a weak understanding of isotope structure and basic atomic composition.
Image of Weaker Response	 a. Identify element **X**. (1 Mark) oxygen b. If the element **X** forms an ion $\mathbf{X}^{-2}$, then how many valence electrons will this ion contain? (1 Mark) The element X contain 2 valence election. c. An isotope of this element **X** has mass number 18. How many neutrons are there in an atom of this isotope? (1 Mark) Number of Neutrons: 9

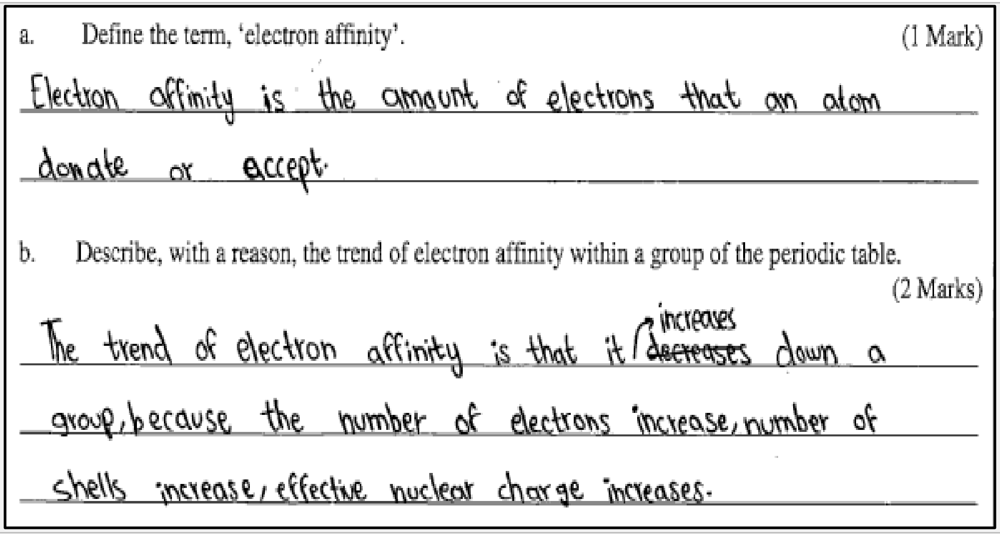
Suggestions for improvement (Highlight all that apply)

Maximising SLO Achievement	**Preferred Pedagogy** Used for this SLO**	**Assessment Strategies**
• Identify the expectation of command words (use Command Word Guide) • Ensure the content is taught at the relevant cognitive level • Identify necessary content required (skills + concepts) • Review past paper questions on the concept • Utilise the resource guide for additional materials	• Story Board • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual Resources • Think, Pair and Share • Knowledge Platform videos • Questioning Technique (Socratic approach) • Practical Demonstration ** For description of each Pedagogy, refer to Annexure A	• Past paper questions • Discussion on E-Marking Notes • AKU-EB Digital Learning Solution powered by Knowledge Platform https://akueb.knowledgeplatform.com/login
Any Additional Suggestion: To address the conceptual gaps observed in candidates' responses, teachers may consider adopting a variety of interactive and conceptually grounded strategies. One effective approach is the use of concept-building worksheets that focus on the relationship between atomic number, element identity, electronic configuration, and ion formation. These worksheets can include structured activities such as matching protons with elements, drawing Bohr models, and explaining charge implications. Additionally, scaffolded assessment tools like table completion and fill-in-the-blanks exercises can be useful. These activities require candidates to fill in atomic number, mass number, protons, neutrons, electrons, and charge, thereby reinforcing the distinctions between total and valence electrons, as well as the impact of ionic charge. Hands-on activities and Do It Yourself (DIY) models using simple craft materials can further enhance learning by making abstract ideas like octet completion and isotopic variation more tangible and memorable. Visual aids, including Bohr and Lewis structures, should also be integrated into instruction to help candidates develop mental models of atomic and ionic changes. These visual representations support deeper conceptual understanding and can improve recall during assessments. Collectively, these strategies aim to move candidates beyond rote memorisation toward meaningful, lasting understanding.		

*K = Knowledge U = Understanding A = Application and other higher-order cognitive skills

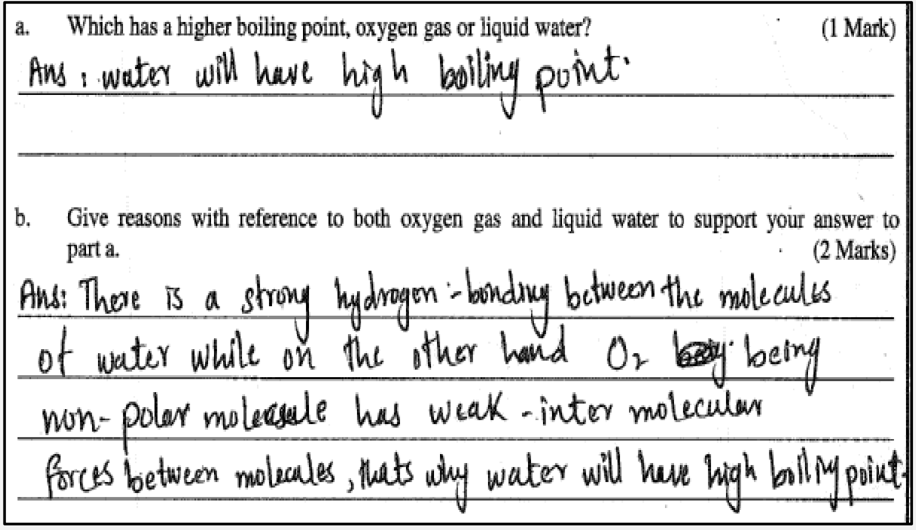
Question No. 2	
Question Text	a. Define the term, 'electron affinity'. b. Describe, with a reason, the trend of electron affinity within a group of the periodic table.
SLO No.	3.2.3
SLO Text	Explain the periodic trend of the following within a group and a period of the periodic table: a. shielding effect b. electronegativity c. atomic radii d. electron affinity e. ionisation energy.
Max Marks	3
Cognitive Level	U
Checking Hints	a. 1 mark for the definition of electron affinity b. 1 mark for the electron affinity trend in a group 1 mark for writing the reason for the trend in the group

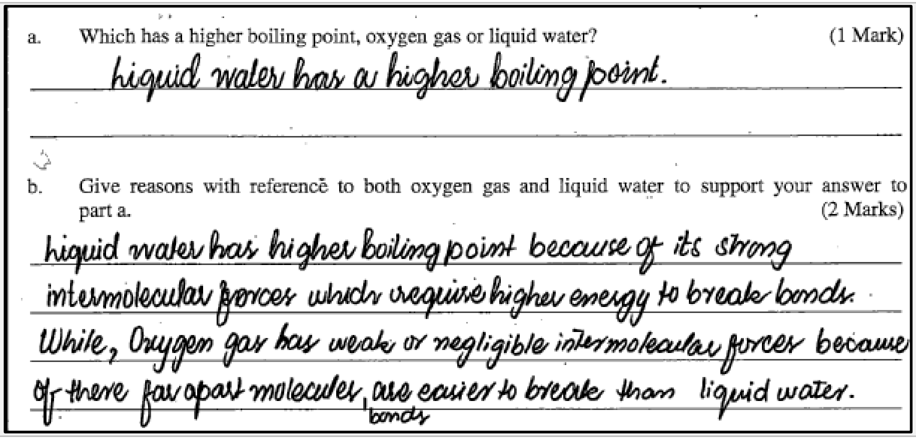
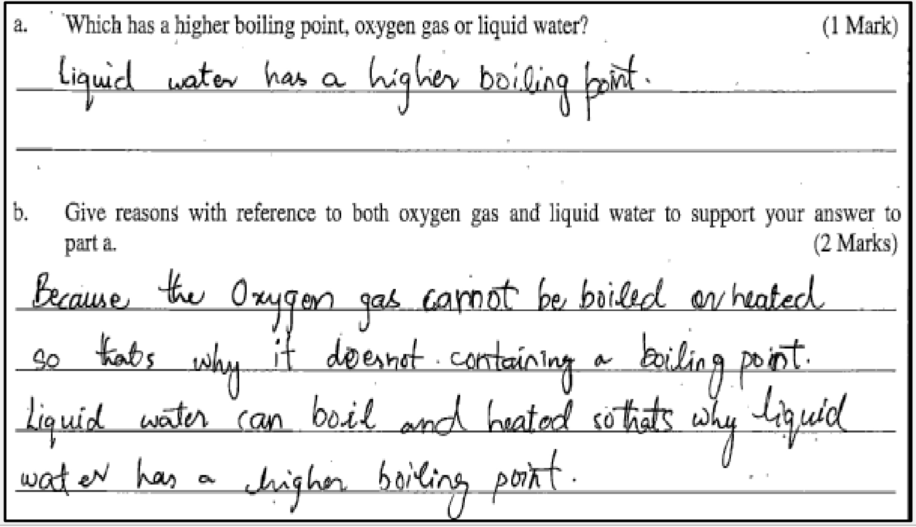
Overall Performance	Overall, candidates' responses reflected a mixed understanding of electron affinity. While some correctly defined the term and explained the group trend using atomic size and shielding effects, many confused it with related concepts such as electronegativity or ionisation energy. Several candidates also provided the trend across a period instead of within a group, or used incorrect reasoning based on electron count. These patterns highlight the need for clearer distinctions between periodic properties and a stronger conceptual foundation.
Description of Better Responses	In part (a), *better responses* accurately defined electron affinity as the amount of energy released when a neutral atom in the gaseous state gains an electron to form a negative ion. These candidates demonstrated clarity in using precise scientific terminology, emphasising that the process occurs in the gaseous phase and results in the formation of an anion. In part (b), candidates correctly described that electron affinity generally decreases down a group. Their reasoning was appropriately linked to atomic properties such as increasing atomic radius and enhanced electron shielding, both of which reduce the effective nuclear attraction for an added electron. Some responses further explained that larger atoms have a lower tendency to gain additional electrons due to the weaker nuclear pull. This level of explanation reflected a solid understanding of periodic trends and the atomic structure underlying them.
Images of Better Responses	 a. Define the term, 'electron affinity'. (1 Mark) The amount of energy released when an electron is added to outermost Shell of isolated gaseous atom. b. Describe, with a reason, the trend of electron affinity within a group of the periodic table. (2 Marks) As we move down the group the electron affinity decreases because atomic radius increase which decreases the effective nuclear charge by increasing the shielding effect so less amount of energy is released when an electron is added to outermost shell.
Description of Weaker Responses	*Weaker responses* revealed considerable confusion in defining electron affinity in part (a). Instead of identifying it as the energy released when a neutral gaseous atom gains an electron, many candidates mistakenly defined it as electronegativity (the ability of an atom to attract electrons in a bond), ionisation energy (the energy required to remove an electron), or even metallic character. These inaccuracies indicate that candidates were mixing related periodic trends without fully understanding their distinct definitions or applications. For part (b), candidates commonly failed to describe the trend of electron affinity within a group. Some incorrectly stated that it increases down the group or gave period-based trends (e.g., "it increases across a period"), which were not relevant to the question. Additionally, many candidates gave flawed reasoning, such as linking the trend to an increase in the number of electrons instead of recognising the impact of increasing atomic size and additional electron shells, which reduce the attraction between the nucleus and an incoming electron. Several weaker responses were also poorly structured, containing contradictory or vague statements such as "it increases and also decreases," which made the answers unclear and showed a lack of organised thinking.

Images of Weaker Responses	 a. Define the term, 'electron affinity'. (1 Mark) Electron affinity is the amount of electrons that an atom donate or accept. b. Describe, with a reason, the trend of electron affinity within a group of the periodic table. (2 Marks) The trend of electron affinity is that it increases ~~decreases~~ down a group, because the number of electrons increase, number of shells increase, effective nuclear charge increases.

Suggestions for improvement (Highlight all that apply)

Maximising SLO Achievement	**Preferred Pedagogy Used for this SLO**	**Assessment Strategies**
- Identify the expectation of command words (use Command Word Guide) - Ensure the content is taught at the relevant cognitive level - Identify necessary content required (skills + concepts) - Review past paper questions on the concept - Utilise the resource guide for additional materials	- Story Board - Cause and Effect - Fish and Bone - Concept Mapping - Audio Visual Resources - Think, Pair and Share - Knowledge Platform videos - Questioning Technique (Socratic approach) Practical Demonstration	- Past paper questions - Discussion on E-Marking Notes - AKU-EB Digital Learning Solution powered by Knowledge Platform https://akueb.knowledgeplatform.com/login
Any Additional Suggestion: To address the confusion observed in candidates' responses—particularly the mix-up between electron affinity and closely related terms such as electronegativity and ionisation energy—it is essential to strengthen both conceptual clarity and comparative understanding of periodic properties. One effective approach is the use of conceptual videos (e.g., *What is Electron Affinity?* https://www.youtube.com/watch?v=d7lVcc5M5Tg) that visually demonstrate how energy is released when atoms gain electrons, helping candidates grasp the abstract nature of energy changes in atomic processes. Additionally, incorporating question interpretation practice can be valuable; by engaging in activities where they differentiate between similar-sounding terms and justify their reasoning using atomic radius, nuclear charge, and shielding effect, candidates can develop precision in understanding and applying these concepts. Another recommended strategy is the use of visual organisers, such as concept maps or Venn diagrams, to highlight the similarities and differences among periodic trends. You may also refer to the weblink provided in the resource guide for understanding periodic trends. These tools promote metacognition and enhance both recall and application during assessments. Collectively, these strategies aim to move candidates beyond memorisation toward a deeper, interconnected understanding of atomic behaviour and periodicity, enabling accurate application in both structured and conceptual questions.		

Question No. 3	
Question Text	a. Which has a higher boiling point, oxygen gas or liquid water? b. Give reasons with reference to both oxygen gas and liquid water to support your answer to part a.
SLO No.	5.4.1
SLO Text	Explain the properties of liquids and the factors that affect them: a. evaporation b. vapour pressure c. boiling point d. freezing point e. diffusion f. density g. compressibility;
Max Marks	3
Cognitive Level	U
Checking Hints	a. 1 mark for the correct identification b. 1 mark for writing the correct reason for liquid water 1 mark for writing the correct reason for oxygen gas
Overall Performance	Overall, candidates' performance on this question was generally strong, with a substantial proportion achieving full marks. Many correctly identified liquid water as having a higher boiling point than oxygen gas and justified their responses by referencing strong hydrogen bonding. However, some candidates struggled to explain the reasoning accurately. Weaker responses often relied on irrelevant factors such as molar mass, density, or particle size, indicating gaps in understanding the role of intermolecular forces in determining boiling points. These patterns highlight the need to reinforce the conceptual link between intermolecular forces and the energy required for phase changes.
Description of Better Responses	In *better responses* to part (a), candidates correctly identified that liquid water has a higher boiling point than oxygen gas. They demonstrated a clear understanding of how physical state and intermolecular forces influence boiling points. In part (b), these candidates provided accurate and relevant comparisons to support their answers. They explained that liquid water exhibits strong hydrogen bonding, which requires significantly more energy to overcome, leading to a higher boiling point. In contrast, they noted that oxygen gas (O_2) consists of non-polar molecules held together by weak van der Waals (London dispersion) forces. This clear contrast between the strong hydrogen bonds in water and the weak intermolecular forces in oxygen gas reflected a solid grasp of the relationship between intermolecular forces and boiling point.
Image of Better Response	Image i:  a. Which has a higher boiling point, oxygen gas or liquid water? (1 Mark) Ans : water will have high boiling point. b. Give reasons with reference to both oxygen gas and liquid water to support your answer to part a. (2 Marks) Ans: There is a strong hydrogen-bonding between the molecules of water while on the other hand O_2 being non-polar molecule has weak-inter molecular forces between molecules, thats why water will have high boiling point. Image ii:

	 a. Which has a higher boiling point, oxygen gas or liquid water? (1 Mark) liquid water has a higher boiling point. b. Give reasons with reference to both oxygen gas and liquid water to support your answer to part a. (2 Marks) liquid water has higher boiling point because of its strong intermolecular forces which require higher energy to break bonds. While, Oxygen gas has weak or negligible intermolecular forces because of there far apart molecules, are easier to break bonds than liquid water.
Description of Weaker Responses	In *weaker responses* to part (a), some candidates either failed to correctly identify liquid water as having a higher boiling point than oxygen gas or provided vague, unsupported answers that lacked reference to molecular structure or intermolecular forces. In part (b), many candidates were unable to accurately explain the reason for water's higher boiling point. Rather than referencing hydrogen bonding in water and weak van der Waals forces in oxygen gas, they incorrectly attributed boiling point differences to unrelated factors such as molar mass, density, particle size, or distance between particles. For example, some argued that oxygen should have a higher boiling point due to its lighter mass or smaller particle size, reflecting a fundamental misunderstanding of the role of intermolecular forces in phase changes. These responses lacked scientific accuracy and failed to establish the critical link between bonding type and the energy required for phase transition—an essential concept for explaining boiling point trends.
Image of Weaker Response	 a. Which has a higher boiling point, oxygen gas or liquid water? (1 Mark) liquid water has a higher boiling point. b. Give reasons with reference to both oxygen gas and liquid water to support your answer to part a. (2 Marks) Because the Oxygen gas cannot be boiled or heated so thats why it doesnot containing a boiling point. Liquid water can boil and heated so thats why liquid water has a higher boiling point.

Suggestions for improvement (Highlight all that apply)

Maximising SLO Achievement	**Preferred Pedagogy Used for this SLO**	**Assessment Strategies**
• Identify the expectation of command words (use Command Word Guide) • Ensure the content is taught at the relevant cognitive level • Identify necessary content required (skills + concepts)	• Story Board • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual Resources • Think, Pair and Share • Knowledge Platform videos • Questioning Technique (Socratic approach)	• Past paper questions • Discussion on E-Marking Notes • AKU-EB Digital Learning Solution powered by Knowledge Platform https://akueb.knowledgeplatform.com/login

- Review past paper questions on the concept - Utilise the resource guide for additional materials	- Practical Demonstration	
Any Additional Suggestion: The observed misconceptions highlight the need to reinforce candidates' understanding of how intermolecular forces—particularly hydrogen bonding—influence physical properties such as boiling point. To address this, teachers can incorporate visual aids and short video lessons that clearly depict hydrogen bonding and contrast it with weaker forces such as van der Waals interactions (e.g., *Intermolecular Forces* https://teachchemistry.org/classroom-resources/intermolecular-forces-2020). These visualisations help candidates grasp why substances like water, with strong hydrogen bonds, exhibit significantly higher boiling points than non-polar molecules like oxygen. In addition, interactive simulations or virtual labs can allow candidates to explore boiling point trends across different substances, helping them visualise how the type and strength of intermolecular forces determine the energy required for phase change. Complementing this with comparative case studies—such as examining the boiling points of H_2O, O_2, CH_4, and NH_3—can further strengthen understanding by prompting candidates to identify underlying patterns and explain exceptions. Together, these strategies aim to clarify misconceptions and develop an application-oriented understanding of physical properties.		

Question No. 4	
Question Text	Explain why the a. first ionisation energy decreases down the group of alkali metals. b. second ionisation energy of sodium is higher than that of magnesium.
SLO No.	8.2.3
SLO Text	Differentiate between ionisation energies of alkali and alkaline earth metals;
Max Marks	4
Cognitive Level	U
Checking Hints	a. 1 mark for writing the cause (atomic size increases/ shielding effect increases/ number of shells/ period no. increases) 1 mark for writing its effect (attraction of nucleus decreases) b. 1 mark for writing each point either with reference to sodium or magnesium (2 required) OR 1 mark for writing the correct reason about high 2nd IE of sodium 1 mark for writing the correct reason about low 2nd IE of magnesium
Overall Performance	Overall, candidates' performance on this question was unsatisfactory, with only a small proportion achieving full marks and a substantial number scoring zero. While a few were able to clearly explain the trend of decreasing first ionisation energy down the group—citing correct reasoning such as increased atomic size and shielding—many provided incomplete or surface-level responses. A common issue was the failure to explain both cause and effect; for instance, candidates often mentioned atomic radius without linking it to the weakening of nuclear attraction. In part (b), only a limited number of candidates correctly explained why sodium's second ionisation energy is significantly higher than magnesium's, effectively relating it to the removal of an inner-shell electron after sodium achieves a stable octet. Many responses overlooked electronic configuration or misapplied general periodic trends. Additionally, confusion between nuclear charge and effective nuclear charge contributed to vague or inaccurate reasoning. These patterns highlight the need to reinforce candidates' conceptual understanding of ionisation energy and improve their ability to apply this knowledge accurately in specific contexts.

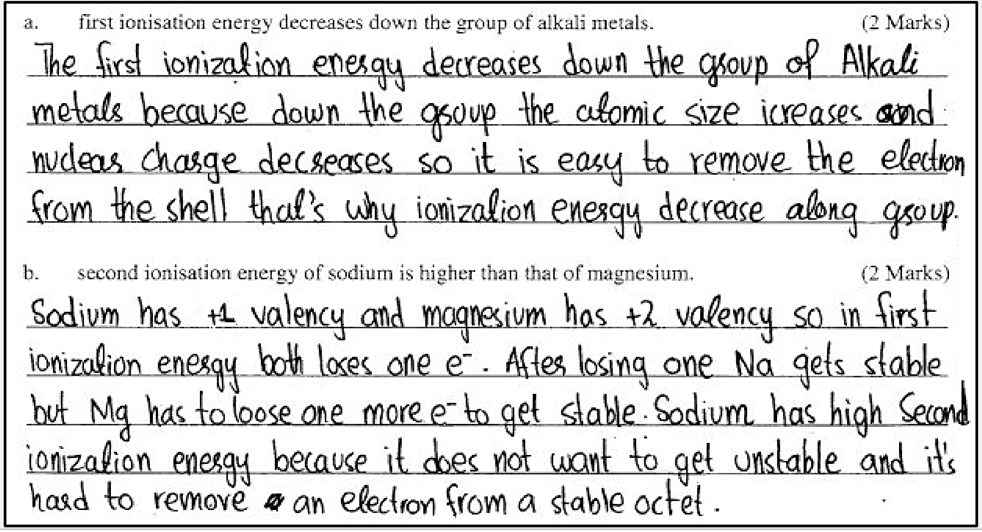
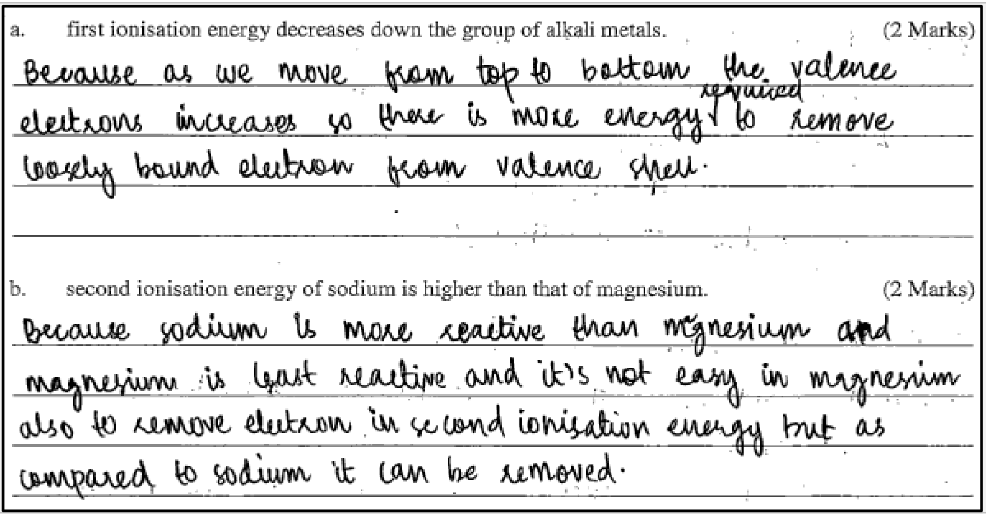
Description of Better Responses	In part (a), *better responses* accurately explained that first ionisation energy decreases down the group of alkali metals due to the increase in atomic size and the number of electron shells. These candidates correctly stated that as one moves down the group, the outermost electron is farther from the nucleus and experiences more electron shielding, which reduces the effective nuclear attraction. As a result, less energy is required to remove the outer electron, leading to a lower first ionisation energy. In part (b), strong responses demonstrated a good understanding of electronic configuration and its impact on ionisation energy. Candidates correctly explained that sodium's second ionisation energy is significantly higher because, after losing one electron, sodium attains a stable noble gas configuration (Ne). The second electron must be removed from a completely filled inner shell, which is much closer to the nucleus and more tightly bound. In contrast, magnesium has two valence electrons, so its second ionisation involves removing another electron from the same outer shell, which requires relatively less energy than disrupting a stable inner shell. These responses showed both conceptual understanding and accurate comparison.
Image of Better Response	 a. first ionisation energy decreases down the group of alkali metals. (2 Marks) The first ionization energy decreases down the group of Alkali metals because down the group the atomic size icreases and nucleas charge decreases so it is easy to remove the electron from the shell that's why ionization energy decrease along group. b. second ionisation energy of sodium is higher than that of magnesium. (2 Marks) Sodium has +1 valency and magnesium has +2 valency so in first ionization energy both loses one e^-. After losing one Na gets stable but Mg has to loose one more e^- to get stable. Sodium has high Second ionization energy because it does not want to get unstable and it's hard to remove an electron from a stable octet.
Description of Weaker Responses	*Weaker responses* in part (a) often failed to explain the cause-and-effect relationship underlying the decreasing trend of first ionisation energy down a group. While many candidates mentioned factors such as increased atomic radius, additional shells, or greater shielding effect, they did not connect these to their consequence—namely, the reduced nuclear attraction on the outermost electron, making it easier to remove. This lack of linkage reflected a superficial understanding of the concept. Additionally, few candidates addressed the role of nuclear charge or effective nuclear charge in counteracting the shielding effect. In some cases, the two terms were used interchangeably or inaccurately, indicating confusion about their meanings. In part (b), most weaker responses did not clearly explain why sodium has a much higher second ionisation energy than magnesium. Many failed to recognise that sodium, after losing one electron, achieves a stable noble gas configuration, and that removing a second electron requires disrupting this stability. Instead, some cited general periodic trends such as "ionisation energy increases across a period," which did not address the specific comparison between second ionisation energies. Moreover, candidates struggled to distinguish between nuclear charge (total number of protons) and effective nuclear charge (net attraction experienced by valence electrons), both of which are key to understanding ionisation energy trends.

Image of Weaker Response	 a. first ionisation energy decreases down the group of alkali metals. (2 Marks) Because as we move from top to bottom the valence electrons increases so there is more energy required to remove loosely bound electron from valence shell. b. second ionisation energy of sodium is higher than that of magnesium. (2 Marks) Because sodium is more reactive than magnesium and magnesium is least reactive and it's not easy in magnesium also to remove electron in second ionisation energy but as compared to sodium it can be removed.

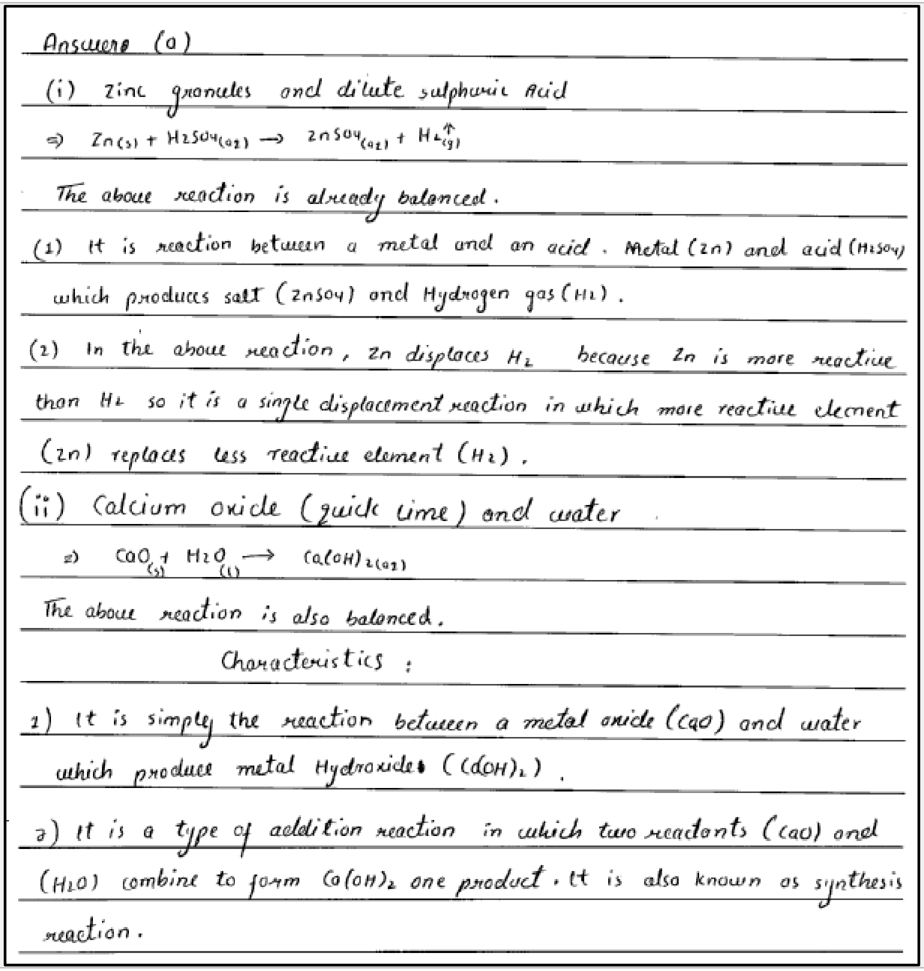
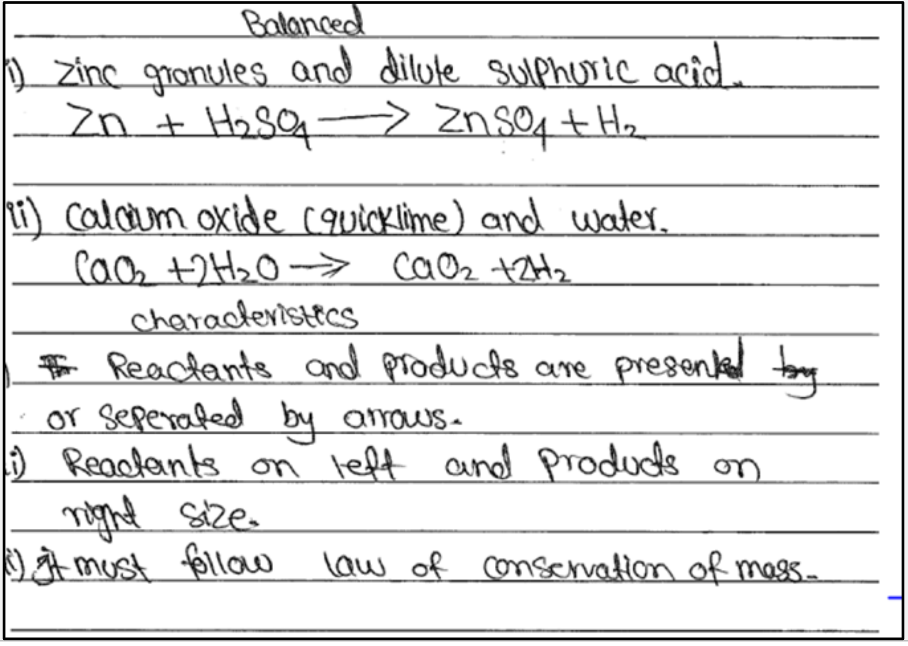
Suggestions for improvement (Highlight all that apply)

Maximising SLO Achievement	**Pedagogy Used for that SLO**	**Assessment Strategies**
• Identify the expectation of command words (use Command Word Guide) • Ensure the content is taught at the relevant cognitive level • Identify necessary content required (skills + concepts) • Review past paper questions on the concept • Utilise the resource guide for additional materials	• Story Board • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual Resources • Think, Pair and Share • Knowledge Platform videos • Questioning Technique (Socratic approach) • Practical Demonstration	• Past paper questions • Discussion on E-Marking Notes • AKU-EB Digital Learning Solution powered by Knowledge Platform https://akueb.knowledgeplatform.com/login
Any Additional Suggestion: To strengthen both conceptual understanding and application skills, teachers can integrate visuals and interactive simulations that depict how atomic radius, shielding effect, and effective nuclear charge influence ionisation energy. Such tools help make the abstract process of electron removal more concrete and comprehensible. Additionally, incorporating past paper questions into regular classroom practice—especially as short, end-of-lesson tasks—can reinforce learning and improve candidates' ability to construct exam-style responses. To further support structured thinking, teachers can introduce guided 'cause-and-effect' response frames. Prompts such as "As we move down the group, the atomic radius increases because... This causes the outer electrons to..." encourage candidates to build complete, logically connected explanations rather than simply listing factors. Collectively, these strategies aim to promote a deeper, more integrated understanding of periodic trends and enable candidates to articulate clear, well-reasoned scientific explanations.		

Extended Response Questions (ERQs)

Extended response questions offered a choice between parts ‘a’ and ‘b’

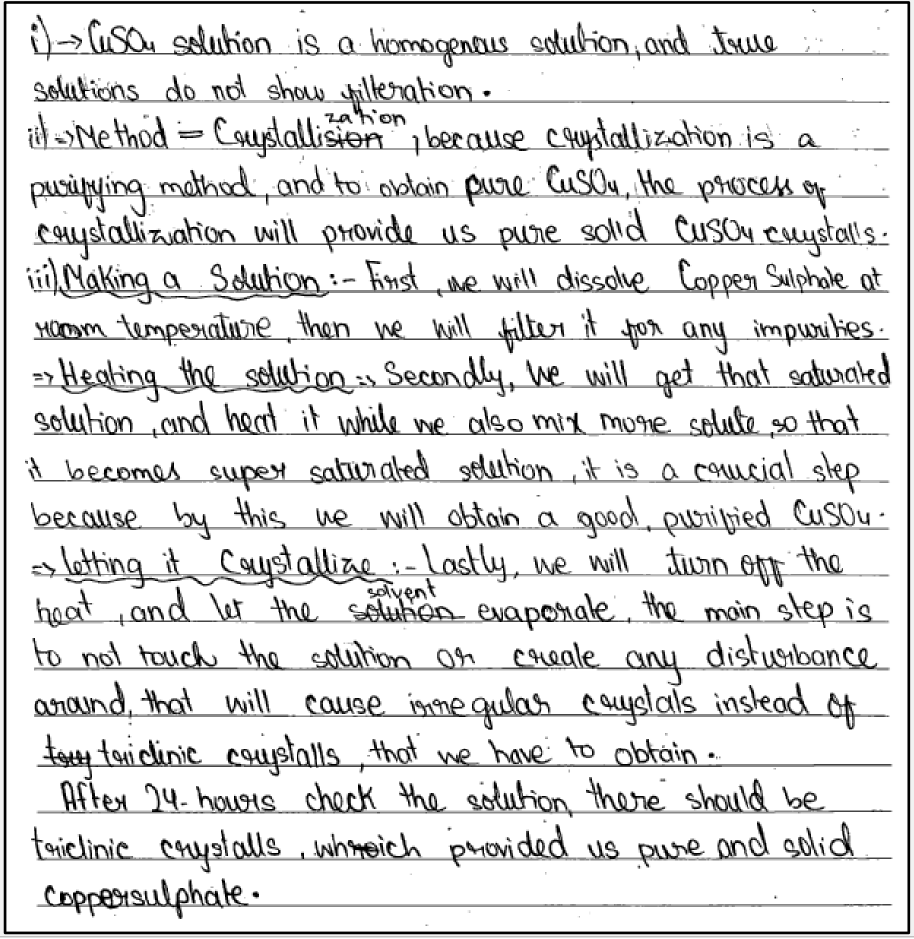
Question No. 5a	
Question Text	In each of the given cases, provide a balanced chemical equation and describe any TWO characteristics of a chemical reaction that occurs between: i. Zinc granules and dilute sulphuric acid ii. Calcium oxide (quicklime) and water
SLO No.	1.5.2
SLO Text	Describe the formation and characteristics of chemical equations;
Max Marks	6
Cognitive Level	U
Checking Hints	i. 1 mark for writing a balanced chemical equation 1 mark for describing each characteristic (2 required) ii. 1 mark for writing a balanced chemical equation 1 mark for describing each characteristic (2 required)
Overall Performance	Only a few candidates attempted this part of the extended response question, and the overall performance was notably weak. A significant majority struggled to demonstrate understanding, with only a handful attaining full marks. While some candidates successfully wrote balanced chemical equations and identified valid characteristics of the reactions, many faced difficulties with foundational concepts. Common errors included the use of incorrect chemical formulas (e.g., calcium hydroxide or copper instead of calcium oxide), misidentification of products (e.g., zinc sulphide instead of zinc sulphate), and vague or inaccurate explanations of reaction characteristics—often stemming from an unclear understanding of reaction types. These gaps highlight the need to reinforce basic chemical knowledge and improve candidates’ ability to link chemical reactions with observable changes.
Description of Better Responses	*Better responses* accurately provided balanced chemical equations for both reactions: i. $Zn_{(s)} + H_2SO_{4(dil)} \rightarrow ZnSO_{4(aq)} + H_{2(g)}$ (Zinc reacts with dilute sulphuric acid to form zinc sulphate and hydrogen gas.) ii. $CaO_{(s)} + H_2O_{(l)} \rightarrow Ca(OH)_{2(aq)}$ (Calcium oxide reacts with water to form calcium hydroxide.) Furthermore, candidates correctly described two valid characteristics of the given chemical reactions. Many accurately identified gas evolution in the reaction between zinc and dilute sulphuric acid and recognised the exothermic nature of both reactions. They also noted the formation of new substances—such as hydrogen gas and calcium hydroxide—and referred to observable physical changes, including changes in state, such as a solid reacting with a liquid to form an aqueous solution. These responses reflected a sound understanding of the indicators of chemical change. In several cases, candidates further strengthened their responses by correctly identifying the type of reaction involved.

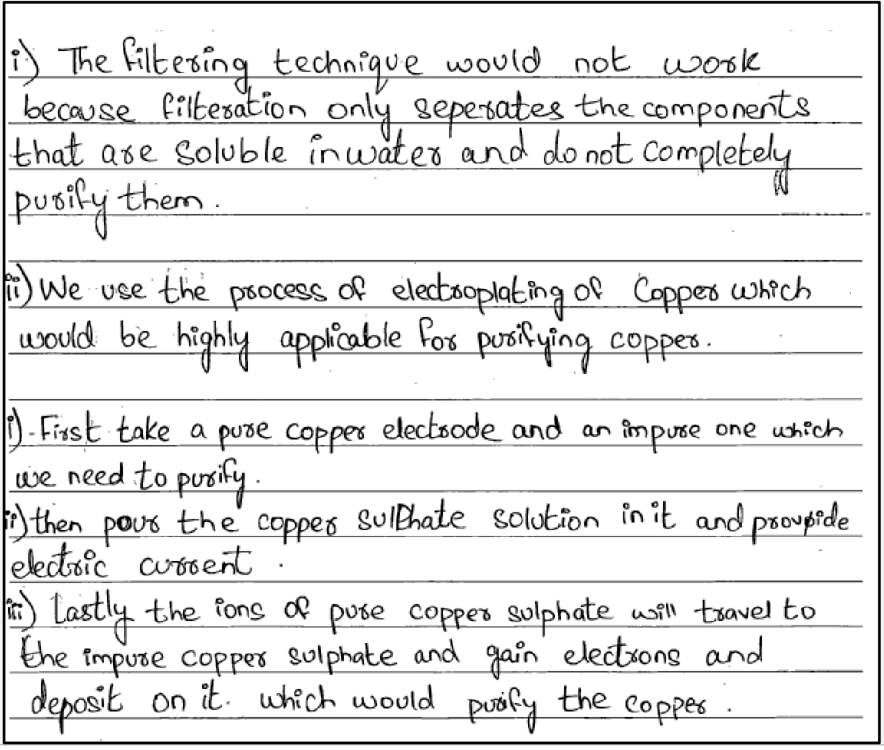
Image of Better Response	 Answere (a) (i) zinc granules and dilute sulphuric Acid ⇒ $Zn_{(s)} + H_2SO_{4(aq)} \longrightarrow ZnSO_{4(aq)} + H_{2(g)}\uparrow$ The above reaction is already balanced. (1) It is reaction between a metal and an acid. Metal (Zn) and acid (H_2SO_4) which produces salt ($ZnSO_4$) and Hydrogen gas (H_2). (2) In the above reaction, Zn displaces H_2 because Zn is more reactive than H_2 so it is a single displacement reaction in which more reactive element (Zn) replaces less reactive element (H_2). (ii) Calcium oxide (quick lime) and water. ⇒ $CaO_{(s)} + H_2O_{(l)} \longrightarrow Ca(OH)_{2(aq)}$ The above reaction is also balanced. Characteristics : 1) It is simply the reaction between a metal oxide (CaO) and water which produce metal Hydroxide ($Ca(OH)_2$). 2) It is a type of addition reaction in which two reactants (CaO) and (H_2O) combine to form $Ca(OH)_2$ one product. It is also known as synthesis reaction.
Description of Weaker Responses	In *weaker responses*, many candidates struggled with writing correct balanced chemical equations. Some confused chemical formulas, such as using calcium hydroxide ($Ca(OH)_2$) instead of calcium oxide (CaO) or mistakenly substituting copper for calcium. Others failed to identify the correct products, commonly writing zinc sulphide (ZnS) or sulphur dioxide (SO_2) instead of the correct products—zinc sulphate ($ZnSO_4$) and hydrogen gas (H_2). Additionally, candidates often failed to connect the observed characteristics to the type of reaction, resulting in vague or irrelevant descriptions. For example, rather than identifying gas evolution or exothermic changes as evidence of chemical reactions, their responses lacked accurate chemical reasoning.
Image of Weaker Response	 Balanced i) zinc granules and dilute sulphuric acid. $Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$ ii) calcium oxide (quicklime) and water. $CaO_2 + 2H_2O \longrightarrow CaO_2 + 2H_2$ characteristics ~~Th~~ Reactants and products are presented ~~by~~ or seperated by arrows. i) Reactants on left and products on right size. i) ~~It~~ must follow law of conservation of mass.

Suggestions for improvement (Highlight all that apply)

Maximising SLO Achievement	Preferred Pedagogy Used for this SLO	Assessment Strategies
• Identify the expectation of command words (use Command Word Guide) • Ensure the content is taught at the relevant cognitive level • Identify necessary content required (skills + concepts) • Review past paper questions on the concept • Utilise the resource guide for additional materials	• Story Board • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual Resources • Think, Pair and Share • Knowledge Platform videos • Questioning Technique (Socratic approach) • Practical Demonstration	• Past paper questions • Discussion on E-Marking Notes • AKU-EB Digital Learning Solution powered by Knowledge Platform https://akueb.knowledgeplatform.com/login
Any Additional Suggestion: To address these misconceptions, teachers should place greater emphasis on correct chemical formula writing, accurate identification of reaction products, and the ability to link chemical reactions to observable characteristics. Conducting practical demonstrations of selected reactions can be especially effective, as they allow candidates to directly witness changes such as gas evolution, temperature shifts, or precipitate formation—bridging theory with real-world observation. Additionally, assigning group projects or presentations on various types of reactions, such as combination, displacement, and neutralisation, promotes collaborative learning and deeper peer-to-peer explanation. Comparative studies can also be introduced, where candidates analyse and differentiate between reaction types based on their reactants, products, and characteristic outcomes. These strategies aim to reinforce foundational concepts and enhance candidates' ability to apply chemical knowledge in both theoretical discussions and practical scenarios.		

Question No. 5b	
Question Text	You have a solution of copper(II) sulphate in water. You want to obtain pure, solid copper(II) sulphate from it. i. Describe why the technique of filtering copper(II) sulphate solution will not work. ii. Which method will you use instead? Give a reason to support your answer. iii. Describe how you will obtain pure, solid copper(II) sulphate in THREE steps using the method identified in part ii.
SLO No.	6.6.2
SLO Text	Describe the process of crystallisation;
Max Marks	6
Cognitive Level	U
Checking Hints	i. 1 mark for describing why filtering does not work ii. 1 mark for naming crystallisation 1 mark for stating the correct reason iii. 1 mark for writing each step (3 required)
Overall Performance	This part of the extended response question was attempted by many candidates, and their performance generally ranged from moderate to high. Most candidates demonstrated a reasonable understanding of the nature of solutions and the principle behind crystallisation, though the depth and clarity of explanation varied. A significant number correctly identified why filtration was not appropriate and recognised crystallisation as a suitable technique. However, only the more well-developed responses presented a clearly reasoned justification along with a structured three-step process. Despite occasional conceptual gaps—such as

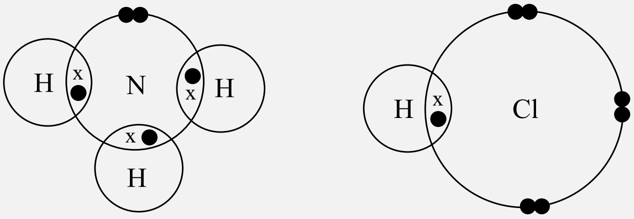
	confusion between crystallisation and electroplating—the overall attempt rate and quality suggest that this topic was generally well understood by the candidates.
Description of Better Responses	In part (i) of *better responses,* candidates who responded well demonstrated a sound understanding of solution chemistry. They correctly identified that copper(II) sulphate forms a true solution in water, where the solute is completely dissolved as ions and uniformly distributed throughout the solvent. They explained that filtration is only effective for separating insoluble solids from liquids, and since no solid particles are present in a true solution, filtration would not work in this case. Their answers reflected clarity in distinguishing between suspensions and solutions. In part (ii), high-performing candidates accurately named crystallisation as the appropriate method and supported their choice with a clear rationale. They explained that crystallisation is used to recover solutes from solutions by removing the solvent and allowing the solute to form solid crystals. These candidates also highlighted that copper(II) sulphate remains chemically stable during gentle heating and that its ionic nature makes it ideal for crystallisation, reinforcing their conceptual understanding of both the method and the substance involved. In part (iii), stronger responses provided a well-organised and scientifically correct sequence of steps for obtaining pure copper(II) sulphate crystals. They stated that the solution should first be gently heated to evaporate some water until it becomes saturated. Then, they correctly described that the hot saturated solution should be allowed to cool slowly at room temperature to enable the formation of crystals. Finally, they noted the need to filter out the formed crystals and dry them between filter papers or in a warm place, thus completing the purification process. Their responses reflected both procedural accuracy and conceptual clarity.
Image of Better Response	 i) → $CuSO_4$ solution is a homogenous solution, and true solutions do not show filteration. ii) ⇒ Method = Crystalli~~sion~~zation, because crystallization is a purifying method, and to obtain pure $CuSO_4$, the process of crystallization will provide us pure solid $CuSO_4$ crystalls. iii) Making a Solution :- First, we will dissolve Copper Sulphate at room temperature, then we will filter it for any impurities. ⇒ Heating the solution :- Secondly, we will get that saturated solution, and heat it while we also mix more solute, so that it becomes super saturated solution, it is a crucial step because by this we will obtain a good, purified $CuSO_4$. ⇒ letting it Crystallize :- Lastly, we will turn off the heat, and let the ~~solution~~ solvent evaporate, the main step is to not touch the solution or create any disturbance around, that will cause irregular crystals instead of ~~tery~~ triclinic crystalls, that we have to obtain. After 24-hours check the solution, there should be triclinic crystalls, wh~~ro~~ich provided us pure and solid coppersulphate.
Description of Weaker Responses	In part (i), *weaker responses* revealed that many candidates lacked a clear understanding of the nature of solutions. They failed to recognise that copper(II) sulphate, when dissolved in water, forms a homogeneous mixture of solvated ions. Since all solute particles are at the molecular or ionic level, no solid residue remains that could be separated through filtration.

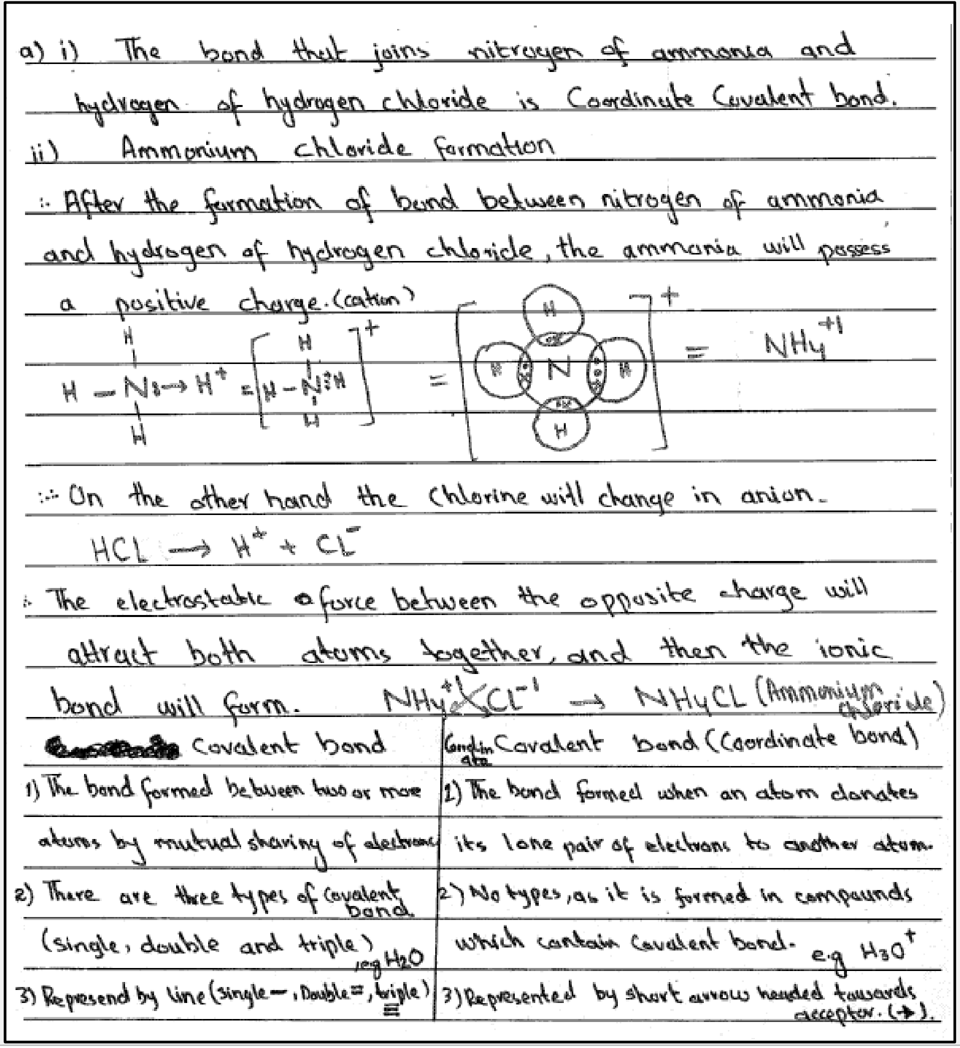
	Instead, candidates mistakenly referred to filtration as a method to remove “impurities” without specifying whether these impurities were insoluble or even present, indicating a confusion between filtration of suspensions and solutions. Some also treated the solution as if it contained undissolved $CuSO_4$, suggesting a poor grasp of solubility concepts. In part (ii), while some candidates correctly identified crystallisation as the appropriate technique to obtain pure, solid copper(II) sulphate, their responses lacked proper justification. They often failed to explain that crystallisation is used for recovering solutes from solutions by controlled evaporation of the solvent, allowing pure crystals to form. In *weaker responses*, candidates simply named the method without linking it to the solubility behaviour of $CuSO_4$ or its stability upon gentle heating. Others showed conceptual confusion by suggesting electroplating or reduction methods, assuming the goal was to obtain copper metal instead of the copper(II) sulphate compound, revealing a misinterpretation of the question's objective. In part (iii), the weakest responses lacked completeness and sequence in describing the crystallisation process. While some mentioned evaporation, they either skipped the cooling step—essential for crystal formation—or proceeded directly to drying without any separation of crystals. A few responses even implied that copper(II) sulphate would break down on heating or that sulphate ions could evaporate, both of which are scientifically inaccurate. These misconceptions suggest a poor understanding of both the physical process and chemical stability of ionic compounds during purification.
Image of Weaker Response	 i) The filtering technique would not work because filteration only seperates the components that are soluble in water and do not completely purify them. ii) We use the process of electroplating of Copper which would be highly applicable for purifying copper. i) First take a pure copper electrode and an impure one which we need to purify. ii) then pour the copper sulphate solution in it and provide electric current. iii) Lastly the ions of pure copper sulphate will travel to the impure copper sulphate and gain electrons and deposit on it. which would purify the copper.

Suggestions for improvement (Highlight all that apply)

Maximising SLO Achievement	**Preferred Pedagogy Used for this SLO**	**Assessment Strategies**
• Identify the expectation of command words (use Command Word Guide) • Ensure the content is taught at the relevant cognitive level • Identify necessary content required (skills + concepts)	• Story Board • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual Resources • Think, Pair and Share • Knowledge Platform videos	• Past paper questions • Discussion on E-Marking Notes • AKU-EB Digital Learning Solution powered by Knowledge Platform https://akueb.knowledgeplatform.com/login

- Review past paper questions on the concept - Utilise the resource guide for additional materials	- Questioning Technique (Socratic approach) - Practical Demonstration	
Any Additional Suggestion: To address misconceptions around separation techniques and strengthen procedural understanding, teachers can implement a range of interactive and reflective strategies. Engaging candidates in a structured hands-on crystallisation activity allows them to observe and follow each step of the process, reinforcing correct methodology through direct experience. Complementing this with error identification tasks—such as presenting improperly formed crystals or an incomplete procedure—encourages critical thinking as candidates identify what went wrong and suggest corrective steps. Additionally, using interactive digital resources like animations or simulations can help visually differentiate between techniques such as filtration, crystallisation, sublimation and evaporation, clarifying when and why each method is used (You may refer to videos on separating mixtures by Next Generation Science or on separation techniques by Cognito on YouTube). Sequencing assessments, where candidates arrange jumbled steps of a separation procedure and justify their order, further support procedural clarity. Together, these strategies help candidates internalise key concepts and reduce confusion between similar techniques, promoting more accurate application in both practical and theoretical contexts.		

Question No. 6a	
Question Text	Given below are the dot and cross structures of ammonia and hydrogen chloride. These two molecules on combining form ammonium chloride.  i. Name the bond that joins nitrogen of ammonia and hydrogen of hydrogen chloride. ii. Describe the formation of ammonium chloride. iii. Write THREE differences between the bond identified in part i and the one that already exists between nitrogen and hydrogen in ammonia.
SLO No.	4.4.3
SLO Text	Compare the formation and characteristics of coordinate covalent compounds with covalent compounds;
Max Marks	6
Cognitive Level	U
Checking Hints	i. 1 mark for naming the bond, i.e., coordinate covalent bond ii. 1 mark for writing about donation of lone pair of electrons by nitrogen of ammonia forming ammonium ion 1 mark for writing about the formation of ionic bond between ammonium ion and chloride ion iii. 1 mark for writing each difference between coordinate covalent and covalent bonds (3 required)
Overall Performance	This part of the extended response question was attempted by a similar number of candidates as the other part, but overall performance remained low to moderate. A few candidates demonstrated a sound understanding of coordinate covalent bonding and its role in the formation of ammonium chloride, clearly distinguishing between covalent and coordinate covalent bonds. However, many responses were either incomplete or revealed

	fundamental misconceptions—particularly in identifying the correct type of bond, explaining the full formation of ammonium chloride (including the ionic bond with the chloride ion), and differentiating between types of bonding rather than focusing on physical properties of compounds. This suggests a need for greater emphasis on applying bonding concepts across related contexts and interpreting multi-part questions holistically.
Description of Better Responses	*Better responses* demonstrated that candidates could accurately identify the bond formed between the nitrogen atom of ammonia and the hydrogen atom of hydrogen chloride as a coordinate covalent bond (also called a dative bond), where both electrons in the shared pair originate from the nitrogen's lone pair. In part (ii), strong responses clearly described the formation of ammonium chloride in two stages: first, the lone pair on the nitrogen atom of ammonia is donated to a hydrogen ion (H^+) from hydrogen chloride, forming the ammonium ion (NH_4^+) through a coordinate covalent bond; second, this positively charged ion combines electrostatically with the chloride ion (Cl^-), forming an ionic compound, ammonium chloride (NH_4Cl). In part (iii), well-prepared candidates clearly articulated the differences between covalent and coordinate covalent bonds. They explained that in a covalent bond, each atom contributes one electron to the shared pair, whereas in a coordinate bond, both electrons originate from a single atom—nitrogen in the case of ammonia. A coordinate bond typically forms when a lone pair is donated to an electron-deficient atom or ion, involving a distinct donor and acceptor relationship. Candidates also pointed out that coordinate bonds are usually formed after a molecule has already achieved a stable configuration, whereas covalent bonds are formed to achieve stability. Although both bond types are similar in strength and structure, the coordinate bond differs in origin due to this lone pair donation. Additionally, coordinate covalent bonds are represented by an arrow pointing from the donor to the acceptor atom, unlike covalent bonds, which are shown as a simple line between atoms.
Images of Better Response	

a) i) The bond that joins nitrogen of ammonia and hydrogen of hydrogen chloride is Coordinate Covalent bond.

ii) Ammonium chloride formation

∴ After the formation of bond between nitrogen of ammonia and hydrogen of hydrogen chloride, the ammonia will possess a positive charge. (cation)

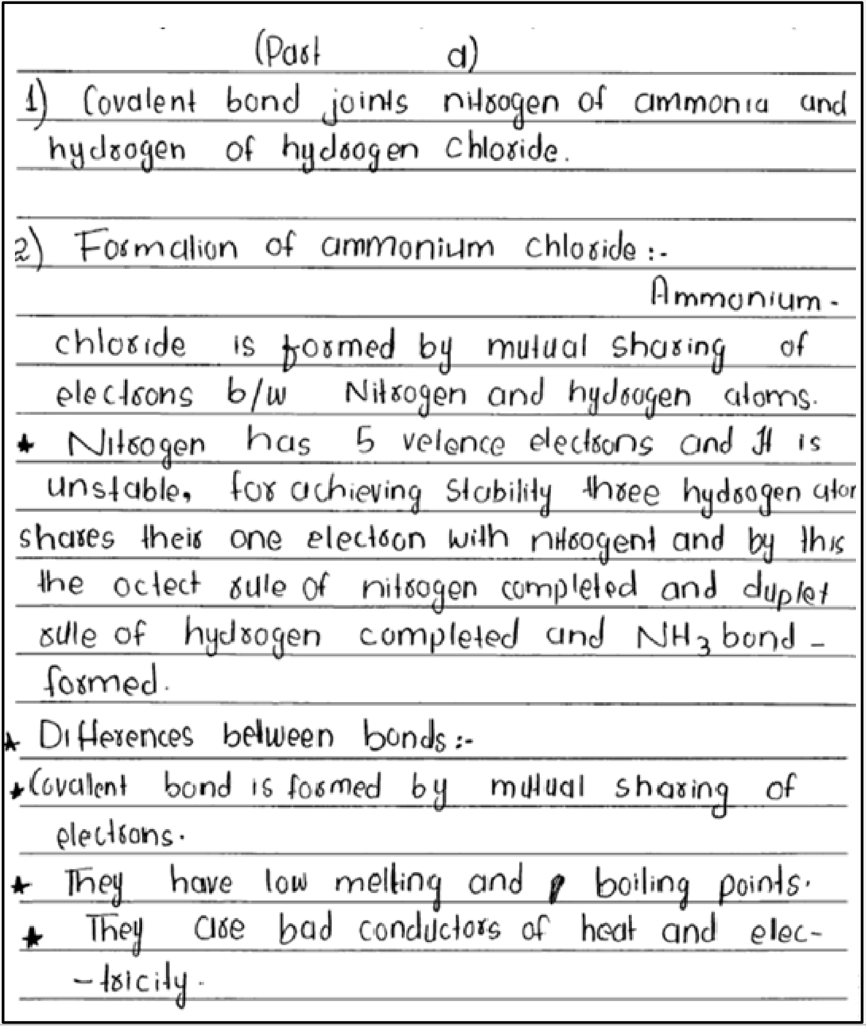
$$H-\overset{H}{\underset{H}{N}}:\rightarrow H^+ = \left[H-\overset{H}{\underset{H}{N}}:H\right]^+ = [\ \ ]^+ = NH_4^{+1}$$

∴ On the other hand the Chlorine will change in anion.

$$HCL \longrightarrow H^+ + CL^-$$

∴ The electrostatic force between the opposite charge will attract both atoms together, and then the ionic bond will form. $NH_4^+ + CL^{-1} \rightarrow NH_4CL$ (Ammonium chloride)

Covalent bond	Coordinate Covalent bond (Coordinate bond)
1) The bond formed between two or more atoms by mutual sharing of electrons	1) The bond formed when an atom donates its lone pair of electrons to another atom.
2) There are three types of covalent bond. (single, double and triple) eg H_2O	2) No types, as it is formed in compounds which contain Covalent bond. e.g H_3O^+
3) Represend by line (single —, Double =, triple ≡)	3) Represented by short arrow headed towards acceptor. (→).

Description of Weaker Responses	*Weaker responses* revealed that candidates struggled to identify the correct type of bond formed between the nitrogen atom of ammonia and the hydrogen atom from hydrogen chloride. Many failed to recognise that this is a coordinate covalent bond, often leaving the part blank or confusing it with a simple covalent, ionic or hydrogen bond. In part (ii), while several candidates were able to describe the formation of the ammonium ion (NH_4^+) by donation of a lone pair from nitrogen, they did not extend their explanation to include the ionic bond formed between the ammonium ion and chloride ion, resulting in an incomplete response. In part (iii), candidates often did not connect their answer back to the bond identified in part (i), instead making incorrect comparisons between ionic and covalent bonds, or ionic and coordinate covalent bonds, thus misinterpreting the requirement. Additionally, many candidates confused the properties of compounds (such as melting point or solubility) with types of bonding, offering physical characteristics of compounds (e.g., “coordinate compounds have low melting points”) rather than describing the nature and formation of the bonds themselves. These misconceptions indicate gaps in foundational understanding of bonding types and their distinguishing features.
Images of Weaker Response	 (Part a) 1) Covalent bond joints nitrogen of ammonia and hydrogen of hydrogen Chloride. 2) Formation of ammonium chloride :- Ammonium-chloride is formed by mutual sharing of electrons b/w Nitrogen and hydrogen atoms. * Nitrogen has 5 velence electrons and it is unstable, for achieving stability three hydrogen ator shares their one electron with nitrogent and by this the octect rule of nitrogen completed and duplet rule of hydrogen completed and NH_3 bond - formed. * Differences between bonds :- * Covalent bond is formed by mutual sharing of electrons. * They have low melting and boiling points. * They are bad conductors of heat and elec-tricity.

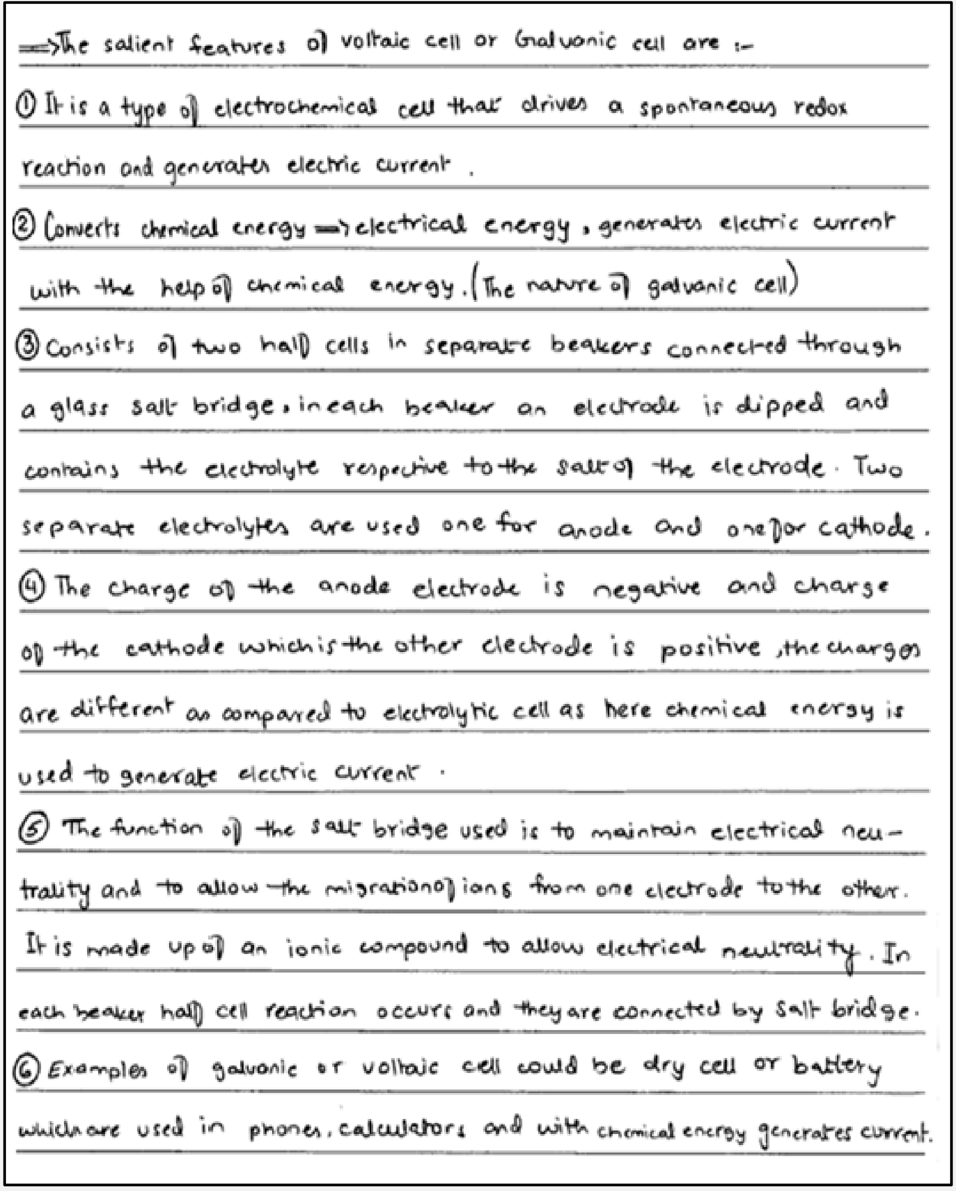
Suggestions for improvement (Highlight all that apply)

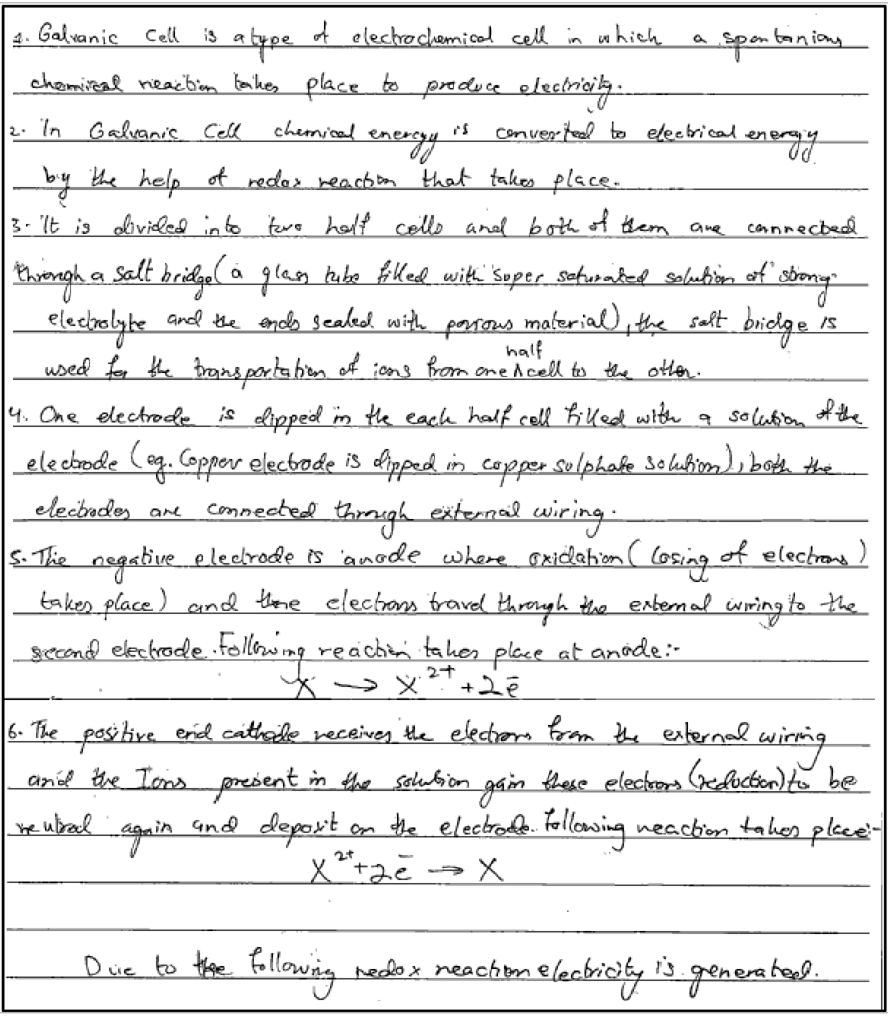
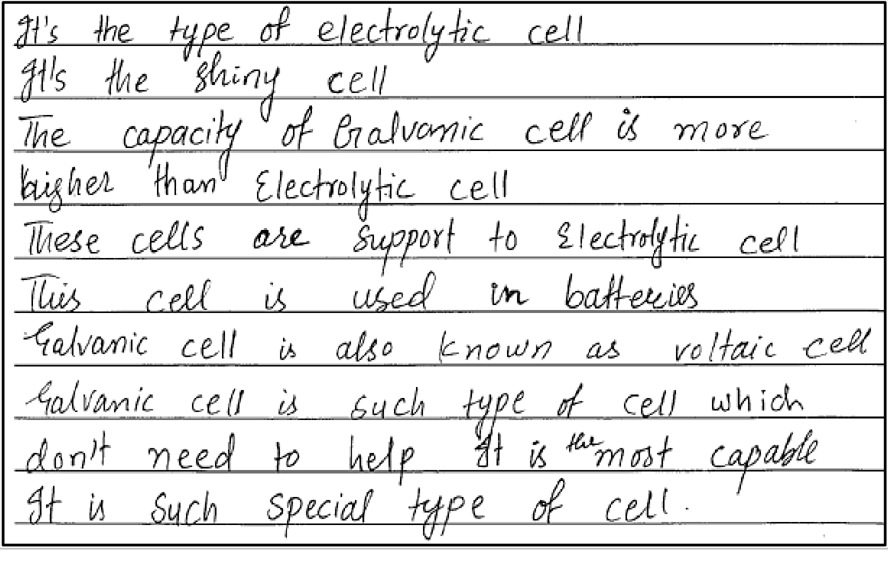
Maximising SLO Achievement	**Pedagogy Used for that SLO**	**Assessment Strategies**
• Identify the expectation of command words (use Command Word Guide)	• Story Board • Cause and Effect • Fish and Bone • Concept Mapping	• Past paper questions • Discussion on E-Marking Notes • AKU-EB Digital Learning Solution powered by Knowledge Platform https://akueb.knowledgeplatform.com/login

• Ensure the content is taught at the relevant cognitive level • Identify necessary content required (skills + concepts) • Review past paper questions on the concept • Utilise the resource guide for additional materials	• Audio Visual Resources • Think, Pair and Share • Knowledge Platform videos • Questioning Technique (Socratic approach) • Practical Demonstration	

Any Additional Suggestion: Given that only a minority of candidates attempted this extended response question—and many displayed misconceptions regarding different types of bonding—targeted instructional strategies are essential to build conceptual clarity. A structured comparative study of ionic, covalent, and coordinate covalent bonds can be highly effective, especially when anchored in familiar examples such as NH_3 (covalent), NH_4^+ (coordinate covalent), and NH_4Cl (ionic interaction). Using animations or detailed diagrams to illustrate the step-by-step formation of coordinate covalent bonds—highlighting lone pair donation and resulting charge separation—can further support visual learning and comprehension. Bond type sorting activities, where candidates classify and justify bonding in various molecules, promote critical thinking and application. Scaffolded practice with dot-and-cross diagrams, particularly focusing on molecules like NH_4^+, reinforces representational skills and deepens understanding. Together, these strategies aim to bridge conceptual gaps and equip candidates with both the foundational and applied knowledge required to confidently address bonding-related questions in future assessments.

Question No. 6b	
Question Text	Describe any SIX features of a voltaic cell (Galvanic cell).
SLO No.	7.4.13
SLO Text	Differentiate between electrolytic and voltaic (Galvanic) cells;
Max Marks	6
Cognitive Level	U
Checking Hints	1 mark for writing each feature of a voltaic cell (any 6 required)
Overall Performance	This part of the extended response question was attempted by a similar number of candidates as the other part, and the overall performance was generally strong. Most candidates were able to secure marks tilted towards the maximum by correctly identifying and listing six valid features of a voltaic (Galvanic) cell. Their responses demonstrated a sound understanding of the structure and functioning of the cell, such as the spontaneous nature of the redox reaction, electron flow from anode to cathode, and the role of the salt bridge in maintaining electrical neutrality. While a few candidates confused characteristics with applications or specific examples, these were in the minority. Overall, this question was well-attempted and reflected a solid grasp of core electrochemical concepts.
Description of Better Responses	*Better responses* demonstrated that candidates had a clear and accurate understanding of voltaic (Galvanic) cells. They were able to correctly describe six relevant features, such as: 1. Spontaneous Chemical Reaction: Candidates explained that a voltaic cell operates based on a spontaneous redox reaction that produces electrical energy. 2. Two Half-Cells: They identified that the cell is composed of two half-cells—each containing an electrode dipped in an electrolyte—where oxidation occurs at the anode and reduction at the cathode.

	3. Electron Flow: The direction of electron flow from the anode (negative electrode) to the cathode (positive electrode) through the external circuit was clearly described. 4. Salt Bridge Function: Responses included the purpose of the salt bridge, explaining how it maintains electrical neutrality by allowing ion flow between the two half-cells. 5. Electrode Materials: Candidates correctly mentioned that electrodes are typically made of metals, and the choice depends on their position in the reactivity series. 6. Energy Conversion: Candidates articulated that a voltaic cell converts chemical energy into electrical energy, which is a key distinguishing feature from electrolytic cells. These responses reflected a well-rounded understanding of both the structure and function of a Galvanic cell, with appropriate use of scientific terminology and accurate descriptions of the components and their roles.
Images of Better Responses	Image i:  ⟹The salient features of voltaic cell or Galvonic cell are :- ① It is a type of electrochemical cell that drives a spontaneous redox reaction and generates electric current. ② Converts chemical energy ⟹ electrical energy, generates electric current with the help of chemical energy. (The nature of galvanic cell) ③ Consists of two half cells in separate beakers connected through a glass salt bridge, in each beaker an electrode is dipped and contains the electrolyte respective to the salt of the electrode. Two separate electrolytes are used one for anode and one for cathode. ④ The charge of the anode electrode is negative and charge of the cathode which is the other electrode is positive, the charges are different as compared to electrolytic cell as here chemical energy is used to generate electric current. ⑤ The function of the salt bridge used is to maintain electrical neu-trality and to allow the migration of ions from one electrode to the other. It is made up of an ionic compound to allow electrical neutrality. In each beaker half cell reaction occurs and they are connected by salt bridge. ⑥ Examples of galvonic or voltaic cell could be dry cell or battery which are used in phones, calculators and with chemical energy generates current. Image ii:

	 1. Galvanic Cell is a type of electrochemical cell in which a spontanious chemical reaction takes place to produce electricity. 2. In Galvanic Cell chemical energy is converted to electrical energy by the help of redox reaction that takes place. 3. It is divided into two half cells and both of them are connected through a salt bridge(a glass tube filled with super saturated solution of strong electrolyte and the ends sealed with porous material), the salt bridge is used for the transportation of ions from one half cell to the other. 4. One electrode is dipped in the each half cell filled with a solution of the electrode (eg. Copper electrode is dipped in copper sulphate solution), both the electrodes are connected through external wiring. 5. The negative electrode is anode where oxidation(losing of electrons) takes place) and the electrons travel through the external wiring to the second electrode. Following reaction takes place at anode:- $X \rightarrow X^{2+} + 2\bar{e}$ 6. The positive end cathode receives the electrons from the external wiring and the Ions present in the solution gain these electrons (reduction) to be neutral again and deposit on the electrode. Following reaction takes place:- $X^{2+} + 2\bar{e} \rightarrow X$ Due to the following redox reaction electricity is generated.
Description of Weaker Responses	*Weaker responses* revealed conceptual confusion and a lack of clarity regarding the term ‘features’ or ‘characteristics’ of a voltaic (Galvanic) cell. Many candidates mistakenly listed applications—such as ‘used in batteries’ or ‘used to power devices’—instead of describing structural or functional attributes. Others misinterpreted the scope of the question by naming a specific example, like the Daniell cell, and treating it as a feature rather than discussing general characteristics of voltaic cells. Additionally, some responses focused narrowly on the workings of a particular cell (e.g., the Zn–Cu Daniell cell), failing to explain broader principles such as the spontaneous nature of redox reactions, the direction of electron flow, or the role of the salt bridge. These patterns indicate a need to reinforce the distinction between functions, examples, and structural features, and to help candidates generalise from specific instances to wider scientific concepts.
Image of Weaker Response	 It's the type of electrolytic cell It's the shiny cell The capacity of Galvanic cell is more higher than Electrolytic cell These cells are support to Electrolytic cell This cell is used in batteries Galvanic cell is also known as voltaic cell Galvanic cell is such type of cell which don't need to help It is the most capable It is such special type of cell.

Suggestions for improvement (Highlight all that apply)

Maximising SLO Achievement	**Preferred Pedagogy Used for this SLO**	**Assessment Strategies**
• Identify the expectation of command words (use Command Word Guide) • Ensure the content is taught at the relevant cognitive level • Identify necessary content required (skills + concepts) • Review past paper questions on the concept • Utilise the resource guide for additional materials	• Story Board • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual Resources • Think, Pair and Share • Knowledge Platform videos • Questioning Technique (Socratic approach) • Practical Demonstration	• Past paper questions • Discussion on E-Marking Notes • AKU-EB Digital Learning Solution powered by Knowledge Platform https://akueb.knowledgeplatform.com/login

Any Additional Suggestion:

To support conceptual clarity around galvanic cells and reduce confusion between their characteristics, uses, and examples, teachers can adopt a combination of practical and visual strategies. Demonstrating a simple voltaic cell, such as the zinc-copper Daniell cell, allows candidates to observe key features like electron flow, salt bridge function, and electrode reactions in real time, effectively linking theoretical knowledge to observable outcomes. Complementing this with diagram labelling exercises—where candidates complete partially labelled galvanic cell diagrams—reinforces understanding of essential components, including electrodes and the direction of electron movement. Additionally, worksheet-based assessments can be used to consolidate learning by requiring candidates to label diagrams, identify sites of oxidation and reduction, and write appropriate half equations. These strategies collectively strengthen candidates' grasp of electrochemical concepts and enhance their ability to apply this knowledge accurately in assessments.

Annexure A: Pedagogies Used for Teaching the SLOs

Pedagogy: Storyboard
Description: A visual pedagogy that uses a series of illustrated panels to present a narrative, encouraging creativity and critical thinking. It helps learners organise ideas, sequence events, and comprehend complex concepts through storytelling.
Example: In a Literature class, candidates are tasked with creating storyboards to visually retell a novel. They draw key scenes, write captions, and present their stories to the class, enhancing their reading comprehension and fostering their imagination.

Pedagogy: Cause and Effect
Description: This pedagogy explores the relationships between actions and consequences. By analysing cause-and-effect relationships, learners develop a deeper understanding of how events are interconnected and how one action can lead to various outcomes.
Example: In a History class, candidates study the causes and effects of the Industrial Revolution. They research and discuss how technological advancements in manufacturing led to significant societal changes, such as urbanisation and labour reform movements.

Pedagogy: Fish and Bone
Description: A method that breaks down complex topics into main ideas (the fish) and supporting details (the bones). This visual approach enhances comprehension by highlighting essential concepts and their relevant explanations.
Example: During a Biology class on human anatomy, the teacher uses fish and bone technique to teach about the human skeletal system. The teacher presents the main components of the human skeleton (fish) and elaborates on each bone's structure and function (bones).

Pedagogy: Concept Mapping
Description: An effective way to visually represent relationships between ideas. Learners create diagrams connecting key concepts, aiding in understanding the overall structure of a subject and fostering retention.
Example: In a Psychology assignment, candidates use concept mapping to explore the various theories of personality. They interlink different theories, such as Freud's psychoanalysis, Jung's analytical psychology, and Bandura's social-cognitive theory, to see how they relate to each other.

Pedagogy: Audio Visual Resources
Description: Incorporating multimedia elements like videos, images, and audio into lessons. This approach caters to different learning styles, making educational content more engaging and memorable.
Example: In a General Science class, the teacher uses a documentary-style video to teach about the solar system. The video includes stunning visual animations of the planets, interviews with astronomers, and background music, enhancing candidates' interest and understanding of space.

Pedagogy: Think, Pair, and Share
Description: A collaborative learning technique where candidates ponder a question or problem individually, then discuss their thoughts in pairs or small groups before sharing with the entire class. It fosters active participation, communication skills, and diverse perspectives.
Example: In a Literature in English class, the teacher poses a thought-provoking question about a novel's moral dilemma. Candidates first reflect individually, then pair up to exchange their opinions, and finally participate in a lively class discussion to explore different viewpoints.

Pedagogy: Questioning Technique (Socratic Approach)
Description: Based on Socratic dialogue, this method stimulates critical thinking by posing thought-provoking questions. It encourages learners to explore ideas, justify their reasoning, and discover knowledge through a process of inquiry.
Example: In an Ethics class, the instructor uses the Socratic approach to lead a discussion on the meaning of justice. By asking a series of probing questions, the candidates engage in a deeper exploration of ethical principles and societal values.

Pedagogy: Practical Demonstration
Description: A hands-on approach where learners observe real-life applications of theories or skills. Practical demonstrations enhance comprehension, skill acquisition, and problem-solving abilities by bridging theoretical concepts with real-world scenarios.
Example: In a Food and Nutrition class, the instructor demonstrates the proper technique for filleting a fish. Candidates observe and then practice the skill themselves, learning the practical application of knife skills and culinary precision.

(**Note:** The examples provided in this annexure serve as illustrations of various pedagogies. It is important to understand that these pedagogies are versatile and can be applied across subjects in numerous ways. Feel free to adapt and explore these techniques creatively to enhance learning outcomes in your specific context.)

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