Aga Khan University Examination Board

Notes from E-Marking Centre on SSC-I Chemistry Annual Examination 2023

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 2023 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 fulfill 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.

General Observations

Most candidates achieved success in constructing good responses. Particularly in the case of drawing atomic structure and determining the empirical formula and molecular formula of a compound. Nonetheless, it is essential for teachers to concentrate on the following concepts and provide candidates with more drills and practice to foster a solid understanding.

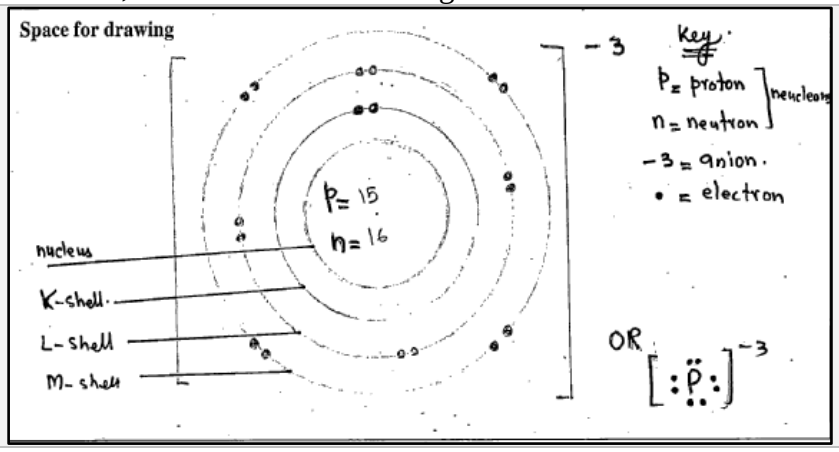
- Electronic configuration in electronic shells with proper placement and calculation of sub-atomic particles.
- Physical properties of elements if placed in the same group in the periodic table.
- Difference between the physical phenomenon of matter (Solid, liquid and gas) based on kinetic molecular theory specifically diffusion and sublimation.
- Factors affecting the rate of diffusion.
- Relationship between pressure volume in a reversible reaction.
- Chemical reaction between elements and writing a balanced chemical equation with a correct representation of molecular and atomic forms of elements.
- Identification of ionic bonds based on the presence of ions of metal and non-metals.
- Calculations related to percentage, mole ratio, molecular mass, simplest ratio, and empirical formula along with mass and number.

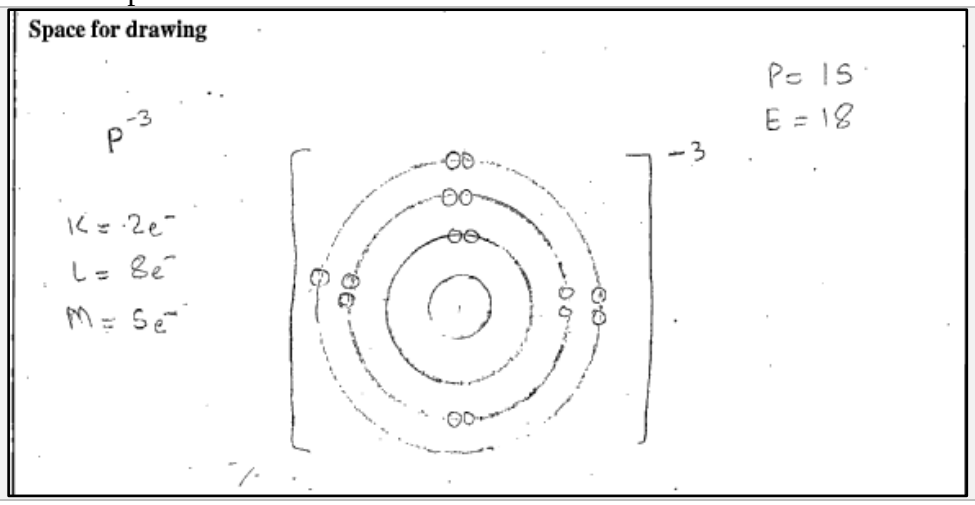
- Stepwise, various methods of crystallisation, and types of solution that are suitable for crystallisation.
- Dot and cross structure of and general properties ionic bond.
- Understanding of general properties (physical and chemical) and formation of bonds.
- Appropriate selection and use of different electrolytic cells for the electrolysis of sodium molten sodium chloride and aqueous sodium chloride.

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	Draw the structure of an ion with the following features. • Charge of −3 • Atomic number = 15 • Nucleon number = 31
SLO No.	2.1.3
SLO Text	Draw the atomic structure of the first twenty elements of the periodic table and their ions using their mass number.
Max Marks	3
Cognitive Level	A*
Checking Hints	1 mark for showing the correct number of shells with electrons 1 mark for showing the nucleus with the correct number of neutrons and protons 1 mark for showing the charge on the ion
Overall Performance	Overall, candidates demonstrated a good understanding of ion formation, particularly for the features given in the question. They accurately depicted the ionic structure of P^{-3} ions showcasing a strong grasp of the concept. However, some candidates exhibited misconceptions with reference to differences in electron numbers after ion formation. To improve weaker responses, candidates should focus on understanding the concept of ions better and emphasise gaining electrons to form an ion rather than assuming equal numbers of protons, neutrons, and electrons.
Description of Better Responses	Better responses showed clarity in illustrating the key components (electron, proton, neutron) with a -3 charge and correctly mentioned the proton number, number of electrons, valence electrons, and the electronic arrangement before and after ion formation.
Image of Better Response	

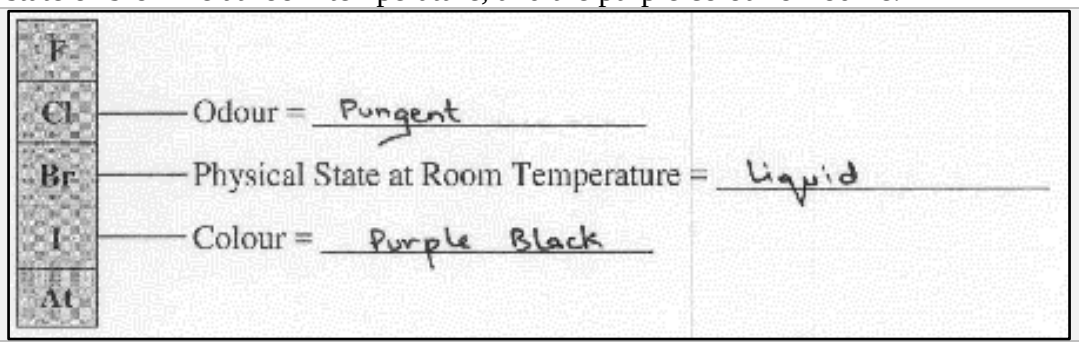
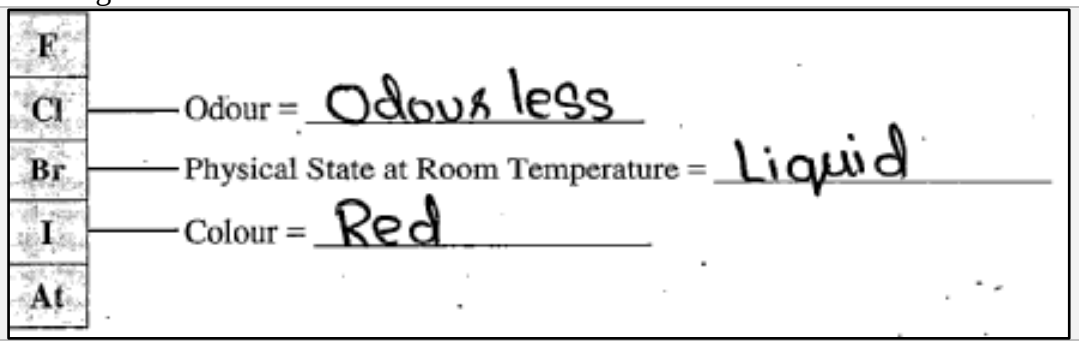
Description of Weaker Responses	Weaker responses displayed some misconceptions regarding ions. While they attempted to draw the structure of P-3/ P^{-3} ions, they showed a lack of understanding of the difference in electron numbers after ion formation. Many incorrectly assumed equal numbers of protons, neutrons, and electrons in the P^{-3} ion. To improve, weaker responses should focus on learning the concept of ions thoroughly, particularly emphasising the gain of electrons, and grasping the concept of valence electrons and their role in ion formation.
Image of Weaker Response	

Suggestions for improvement (Highlight all that apply)

How to Approach SLO	Pedagogy** Used for that SLO	Assessment Strategies
• Understand the expectations of the command words • Look at the cognitive level • Identify the content that is required to answer that question (both in terms of understanding of concepts and any skills that may be required like analysing or evaluating) • Go through the past paper questions on that particular concept • Refer to the resource guide for extra resources	• 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 enhance understanding, candidates should practice more ion-related problems and exercises. Utilising interactive visual aids or simulations can also help to visualise ion formation. Encouraging candidates to study the periodic table and learn how to determine valence electrons for different elements would also be beneficial. Moreover, providing clear explanations of the concept of ions and the significance of electron gain in ion formation would aid candidates in mastering this topic effectively.

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

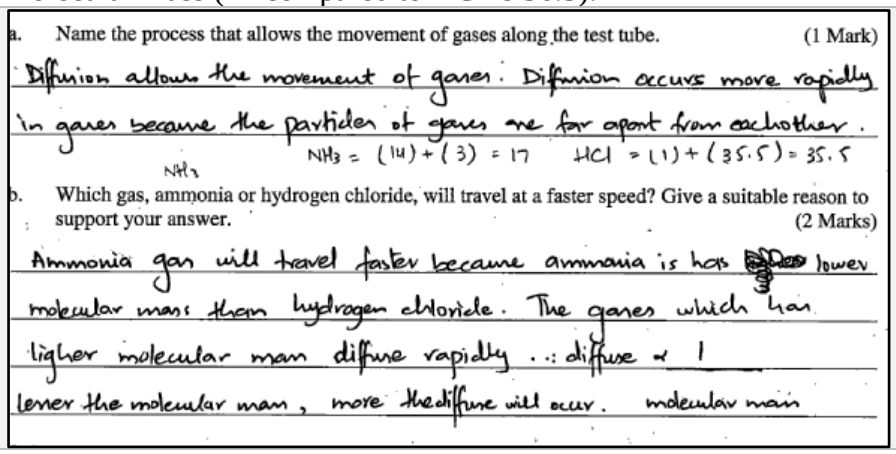
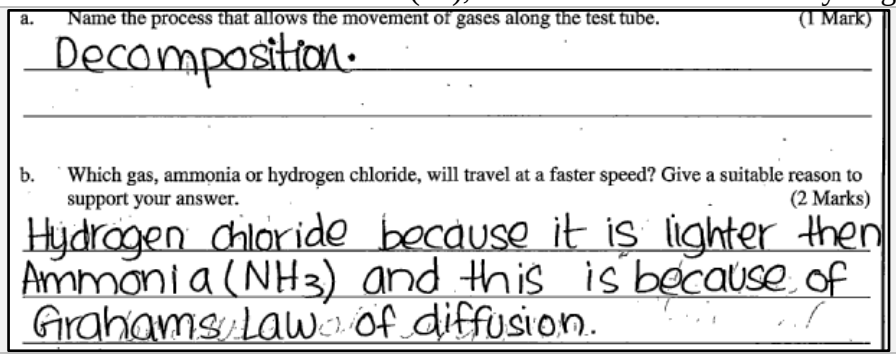
Question No. 2	
Question Text	Complete the following blanks with reference to the physical properties of labelled elements. **F** **Cl** —— Odour = _____ **Br** —— Physical State at Room Temperature = _____ **I** —— Colour = _____ **At**
SLO No.	3.1.6
SLO Text	Discuss the physical and chemical properties of: a. group I b. group II c. group VII d. group VIII.
Max Marks	3
Cognitive Level	K
Checking Hints	1 mark for each correct answer (3 required)
Overall Performance	The overall performance of candidates in understanding the general physical properties of Halogens (Group VII A) was satisfactory. However, weaker responses demonstrated a lack of content knowledge, leading to difficulty in recognising these physical properties correctly.
Description of Better Responses	Better responses exhibited a strong content knowledge and understanding of the general properties of halogens. They accurately identified the pungent odour of chlorine, the liquid state of bromine at room temperature, and the purple colour of iodine.
Image of Better Response	
Description of Weaker Responses	Weaker responses struggled to recognise the physical properties of halogens. They often mistook the order of chlorine for its pungent odour and incorrectly identified chlorine as a colourless gas. Additionally, there were misconceptions about the physical state at room temperature and the colour of bromine and iodine respectively. To improve, weaker responses candidates should thoroughly study and memorise the correct physical properties of halogens.
Image of Weaker Response	

Suggestions for improvement (Highlight all that apply)

How to Approach SLO	Pedagogy Used for that SLO	Assessment Strategies
• Understand the expectations of the command words • Look at the cognitive level • Identify the content that is required to answer that question (both in terms of understanding of concepts and any skills that may be required like analysing or evaluating) • Go through the past paper questions on that particular concept • Refer to the resource guide for extra resources	• 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 reinforce the understanding of halogens' properties, candidates could be encouraged to conduct simple experiments in a controlled environment to observe and experience the odour, state, and colour of halogens themselves. Providing real-world examples of halogens in everyday life, such as disinfectants that contain chlorine or iodine, could also help make the concept more relatable and memorable. Furthermore, quizzes and interactive activities focused on halogen properties would be beneficial for solidifying the knowledge of candidates. Candidates should focus on memorising and understanding the correct physical properties of halogens, utilising mnemonic devices or visual aids to reinforce the information.

Question No. 3	
Question Text	When ammonium chloride (NH_4Cl) is heated in a test tube, it results in the formation of ammonia (NH_3) and hydrogen chloride (HCl) gases. The fumes of the gases can be observed moving along the test tube. (**Note**: Atomic mass of N = 14 amu, H = 1 amu and Cl = 35.5 amu) a. Name the process that allows the movement of gases along the test tube. b. Which gas, ammonia or hydrogen chloride, will travel at a faster speed? Give a suitable reason to support your answer.
SLO No.	5.2.1
SLO Text	Explain the properties of gases: a. diffusion b. effusion c. condensation d. density e. compressibility.
Max Marks	3
Cognitive Level	U
Checking Hints	a. 1 mark for naming the process b. 1 mark for identifying ammonia 1 mark for the correct reason
Overall Performance	Overall, candidates performed moderately in this question. Most candidates were able to correctly identify the process and gas but struggled to give a reason, whereas others gave the correct reason but identified the wrong gas.
Description of Better Responses	In part 'a', candidates accurately identified the given process as 'diffusion'. In part b, they demonstrated clarity in the conceptual understanding of the relationship between molar

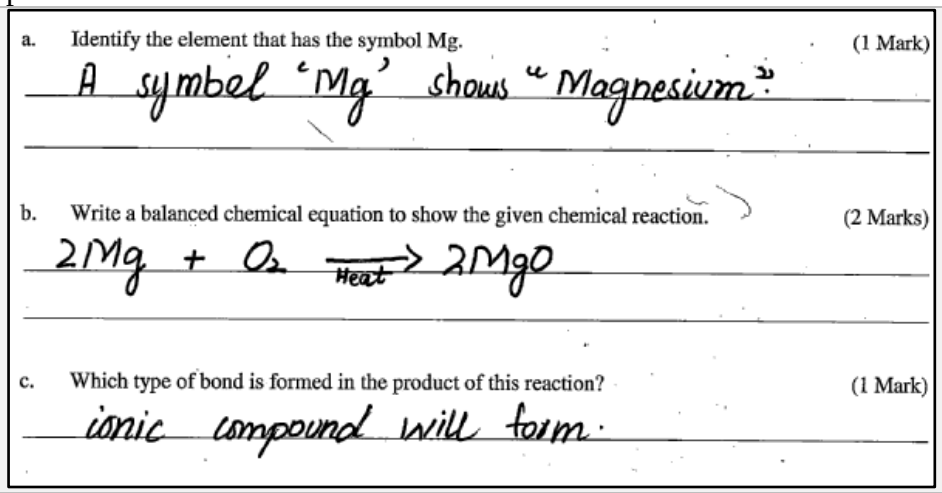
	masses and the rate of diffusion of gases by stating that ammonia has a lower relative molecular mass (17 compared to HCl is 36.5).
Image of Better Response	 a. Name the process that allows the movement of gases along the test tube. (1 Mark) Diffusion allows the movement of gases. Diffusion occurs more rapidly in gases because the particles of gases are far apart from eachother. $NH_3 = (14)+(3) = 17$ $HCl = (1)+(35.5) = 35.5$ b. Which gas, ammonia or hydrogen chloride, will travel at a faster speed? Give a suitable reason to support your answer. (2 Marks) Ammonia gas will travel faster because ammonia is has lower molecular mass than hydrogen chloride. The gases which has ligher molecular mass diffuse rapidly ∴ diffuse ∝ 1 / lower the molecular mass, more the diffuse will occur. molecular mass
Description of Weaker Responses	In part 'a', candidates misunderstood the information given in the question, thus mistaking it for sublimation or decomposition rather than diffusion. In part 'b' weaker responses lacked a clear explanation of the relationship between molar masses and the rate of diffusion. They failed to grasp that lighter gases diffuse faster, and ammonia, being less dense with a lower molar mass (17), would diffuse faster than hydrogen chloride (36.5).
Image of Weaker Response	 a. Name the process that allows the movement of gases along the test tube. (1 Mark) Decomposition. b. Which gas, ammonia or hydrogen chloride, will travel at a faster speed? Give a suitable reason to support your answer. (2 Marks) Hydrogen chloride because it is lighter then Ammonia (NH_3) and this is because of Grahams Law of diffusion.

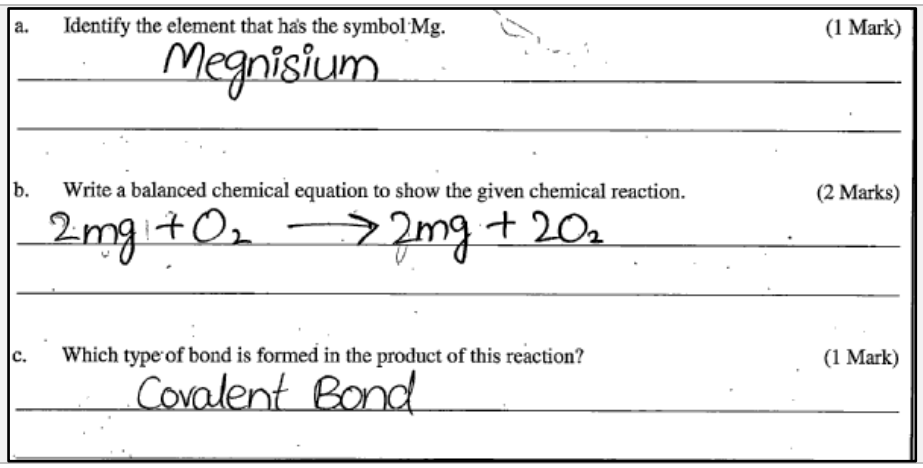
Suggestions for improvement (Highlight all that apply)

How to Approach SLO	Pedagogy Used for that SLO	Assessment Strategies
• Understand the expectations of the command words • Look at the cognitive level • Identify the content that is required to answer that question (both in terms of understanding of concepts and any skills that may be required like analysing or evaluating) • Go through the past paper questions on that particular concept • Refer to the resource guide for extra resources	• 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 improve comprehension of diffusion, candidates should be provided with practical examples of diffusion in daily life, such as the spreading of aroma in a room or the diffusion of gases

in the atmosphere. Teachers can use visual aids, animations, or real-world demonstrations to illustrate diffusion and its significance. To emphasise the importance of molar masses in determining the speed of diffusion and using comparison charts of molar masses of different gases could be helpful in reinforcing the concept. Additionally, encouraging candidates to solve numerical problems involving diffusion rates of gases would further strengthen their understanding.

Question No. 4	
Question Text	When a piece of Mg ribbon is lit, it burns with a dazzling white light. The combination of Mg with oxygen produces a white substance. a. Identify the element that has the symbol Mg. b. Write a balanced chemical equation to show the given chemical reaction. c. Which type of bond is formed in the product of this reaction?
SLO No.	8.2.4
SLO Text	Describe the physical and chemical properties of sodium, calcium and magnesium with respect to their position on periodic table.
Max Marks	4
Cognitive Level	U
Checking Hints	a. 1 mark for the correct identification of magnesium b. 1 mark for writing the correct equation 1 mark for the balancing c. 1 mark for the correct identification of the type of bond
Overall Performance	Overall, candidates performed well in part 'a' by correctly identifying magnesium. However, weaker responses showed poor conceptual knowledge, failing to write the balanced equation correctly in part 'b'. Similarly, candidates faced challenges in the identification of the type of bond in part 'c'. To improve, candidates should focus on understanding the concept of oxidation reactions, practice balancing chemical equations, and grasp the differences between ionic and covalent bonds.
Description of Better Responses	In part 'a', candidates correctly identified magnesium. In part 'b', they demonstrated a clear understanding of the reaction by writing the balanced chemical equation as $2Mg + O_2 \rightarrow 2MgO$. In part 'c', these responses accurately identified the type of bond formed in the product as ionic.
Image of Better Response	 a. Identify the element that has the symbol Mg. (1 Mark) A symbol 'Mg' shows "Magnesium". b. Write a balanced chemical equation to show the given chemical reaction. (2 Marks) $2Mg + O_2 \xrightarrow{Heat} 2MgO$ c. Which type of bond is formed in the product of this reaction? (1 Mark) ionic compound will form.
Description of Weaker Responses	In part 'a', weaker responses incorrectly identified magnesium. In part 'b', candidates failed to write the balanced chemical equation for the reaction, providing unbalanced or incorrect equations. Moreover, some candidates mentioned the correct product (MgO) but struggled to balance the equation as they considered oxygen in its atomic form rather than its molecular form. A few responses also mentioned MgO_2 when they took oxygen in a

	molecular form. In part 'c', weaker responses incorrectly identified the type of bond as covalent instead of ionic.
Image of Weaker Response	

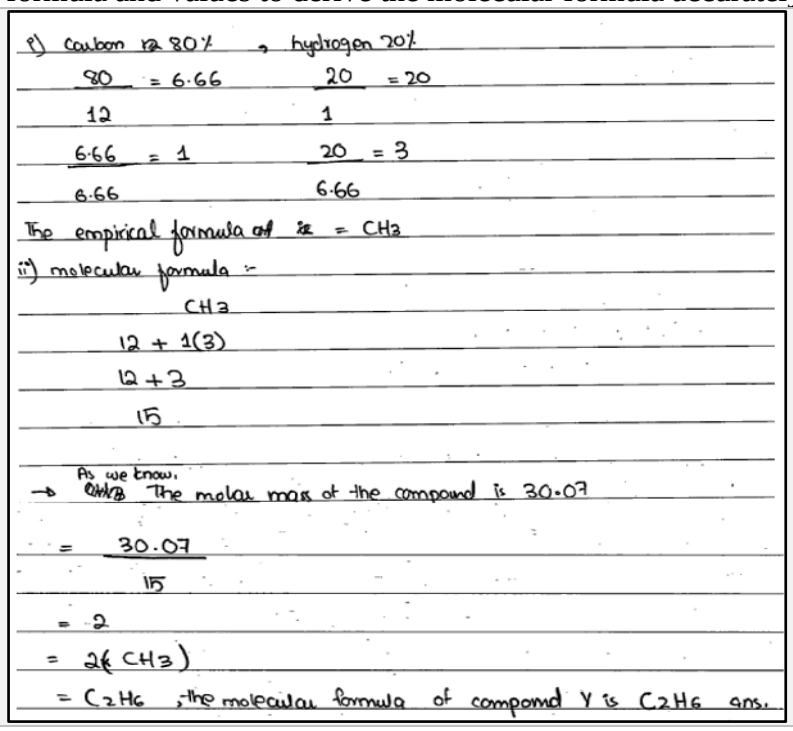
Suggestions for improvement (Highlight all that apply)

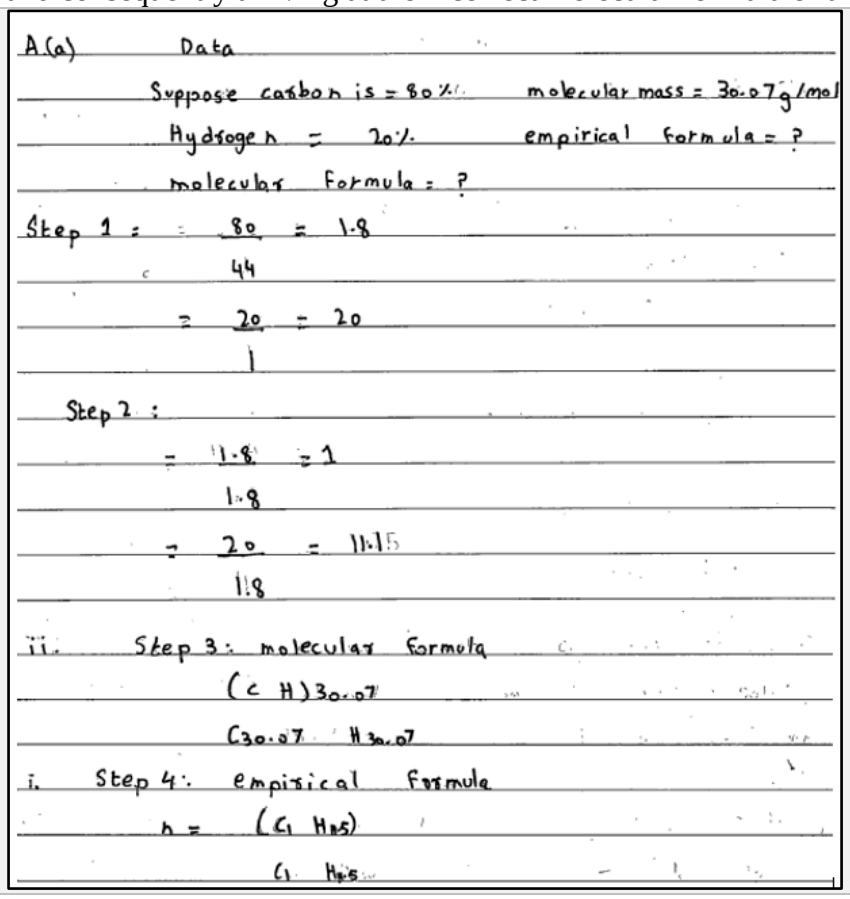
How to Approach SLO	Pedagogy Used for that SLO	Assessment Strategies
• Understand the expectations of the command words • Look at the cognitive level • Identify the content that is required to answer that question (both in terms of understanding of concepts and any skills that may be required like analysing or evaluating) • Go through the past paper questions on that particular concept • Refer to the resource guide for extra resources	• 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 improve conceptual knowledge, candidates should review the basics of chemical reactions and oxidation processes. Practice exercises on writing and balancing chemical equations will help reinforce this skill. For a better understanding of bond types, candidates can study the differences between ionic and covalent bonds and explore examples of each. Teachers can provide visual aids or interactive activities to help students grasp the concept of chemical bonding effectively. Additionally, providing real-life examples of ionic and covalent compounds can make the concept more relatable and memorable.

Extended Response Questions (ERQs)

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

Question No. 5a	
Question Text	An experiment shows that compound Y contains 80% carbon and 20% hydrogen by mass. If the relative molecular mass of this compound is 30.07 g/mol, then i. calculate the empirical formula of the compound Y. ii. determine its molecular formula. (**Note**: Atomic mass of C = 12 amu and H = 1 amu)
SLO No.	1.4.2 (1.4.3)
SLO Text	Calculate empirical formula using the percentages of elements; (calculate the molecular formula using molecular mass and empirical formula.
Max Marks	6
Cognitive Level	A
Checking Hints	i. 1 mark for calculating the number of moles of each element (2 required) 1 mark for the correct empirical formula using the smallest whole-number ratio ii. 1 mark for calculating the empirical formula mass 1 mark for calculating the value of n 1 mark for the correct molecular formula
Overall Performance	Overall, candidates performed well in part ‘i’ by accurately presenting the necessary steps for calculating empirical and molecular formulae. They used correct formulae to determine the number of moles of each element and indicated the simplest atomic ratios for the empirical formula. Some candidates also made errors in formulae and value substitutions, leading to incorrect empirical and molecular formulae.
Description of Better Responses	In part ‘i’, candidates accurately demonstrated the required steps for calculating empirical and molecular formulae, using correct formulae to find the moles of each element, and indicating the simplest atomic ratios for the empirical formula. In part ‘ii’, these responses correctly determined the value of ‘n’ using the appropriate formula and values to derive the molecular formula accurately.
Image of Better Response	

Description of Weaker Responses	In part 'i', weaker responses lacked systematic data presentation and value substitutions, often using percentages directly instead of calculating moles. They also made errors in formula and value substitutions, leading to the incorrect empirical formula of the compound. Similarly, in part ii, candidates continued to struggle, calculating incorrect values for 'n', and consequently arriving at the incorrect molecular formula of the compound.
Image of Weaker Response	

A(a) Data

Suppose carbon is = 80% molecular mass = 30.07 g/mol

Hydrogen = 20% empirical formula = ?

molecular Formula = ?

Step 1 : = 80 = 1.8

44

= 20 = 20

1

Step 2 :

= 1.8 = 1

1.8

= 20 = 11.15

1.8

ii. Step 3: molecular formula

(c H)30.07

C30.07 H30.07

i. Step 4: empirical Formula

n = (C1 H1.5)

C1 H1.5

Suggestions for improvement (Highlight all that apply)

How to Approach SLO	Pedagogy Used for that SLO	Assessment Strategies
• Understand the expectations of the command words • Look at the cognitive level • Identify the content that is required to answer that question (both in terms of understanding of concepts and any skills that may be required like analysing or evaluating) • Go through the past paper questions on that particular concept • Refer to the resource guide for extra resources	• 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 improve performance, candidates should practice solving various problems related to empirical and molecular formulae. Teachers are advised to encourage a step-by-step approach in calculations and emphasise the importance of calculating moles accurately rather than using percentages directly. Providing more examples and exercises with varying complexities will help candidates gain confidence in their skills. Additionally, teachers can offer constructive feedback on calculations, guiding students towards using the correct formulae and value substitutions.

Question No. 5b	
Question Text	You have a solution of copper(II) sulphate in water. You want to obtain 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 solid copper(II) sulphate in THREE steps using the method identified in part ii.
SLO No.	6.6.2
SLO Text	Calculate empirical formula using the percentages of elements; (Calculate the molecular formula using molecular mass and empirical formula.
Max Marks	6
Cognitive Level	A
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	Overall, candidates performed well in part ‘i’ by correctly describing why filtering cannot be used to separate copper sulphate from water, highlighting that copper sulfate is soluble and not an insoluble solid. However, candidates with weaker responses struggled in the later part of the question i.e., parts ‘ii’ and ‘iii’. To improve, candidates should focus on understanding the principles behind separation techniques and enhance their critical thinking abilities.
Description of Better Responses	In part i, better responses precisely described the reason for not using the filtering technique: it separates insoluble solids from the liquid. Likewise, in part ‘ii’, candidates successfully identified the process of crystallisation, through which the copper sulphate can be separated easily. These responses in part ‘iii’, also showed accurate and systematically written steps needed for the separation technique, these included preparing a concentrated and saturated solution of copper(II) sulphate in water by heating it, checking for crystal formation by placing a drop of the solution on a microscope slide, letting the solution cool if crystals form quickly, filtering to remove crystals, rinsing with distilled water and finally dry them with filter paper.

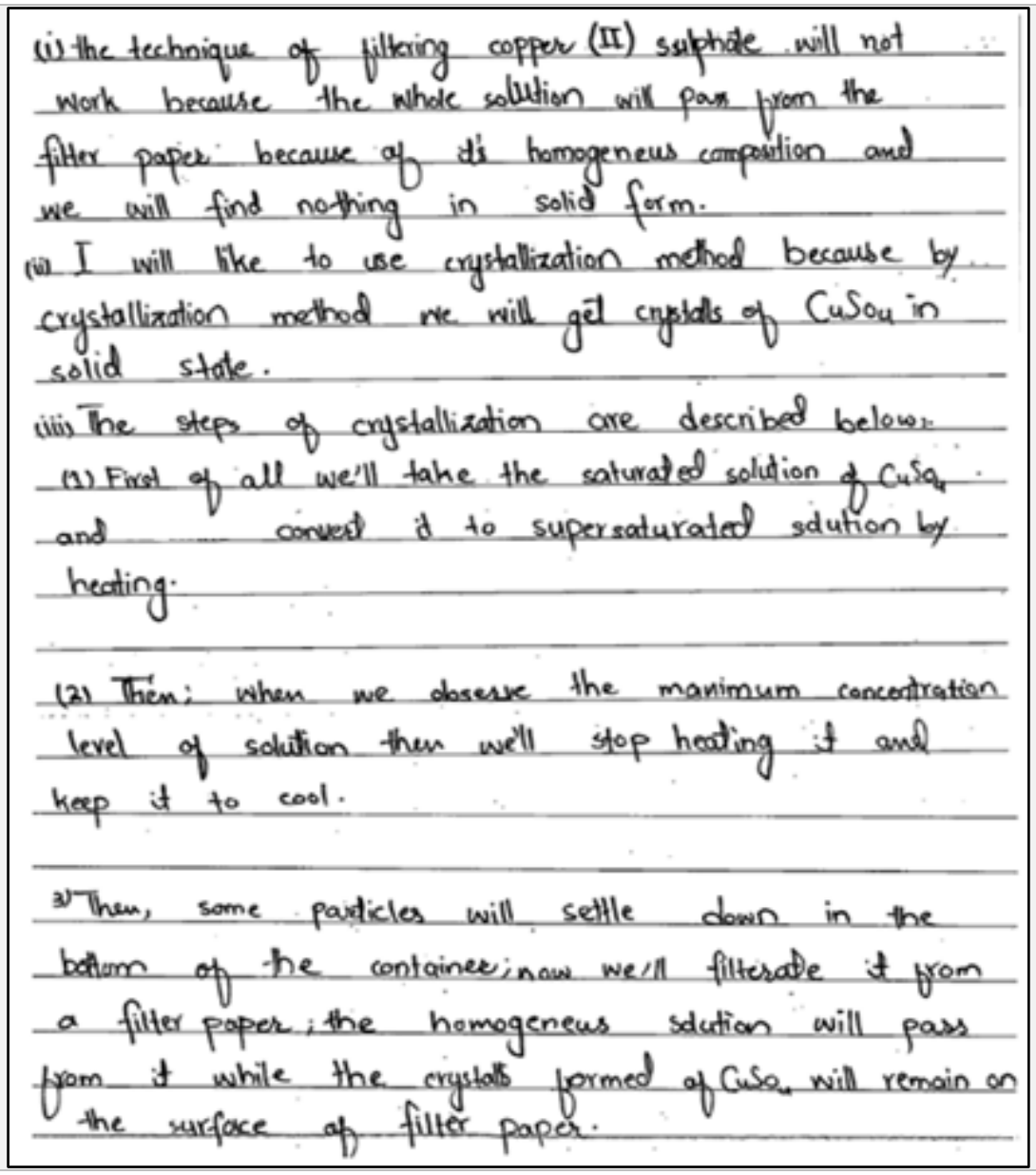
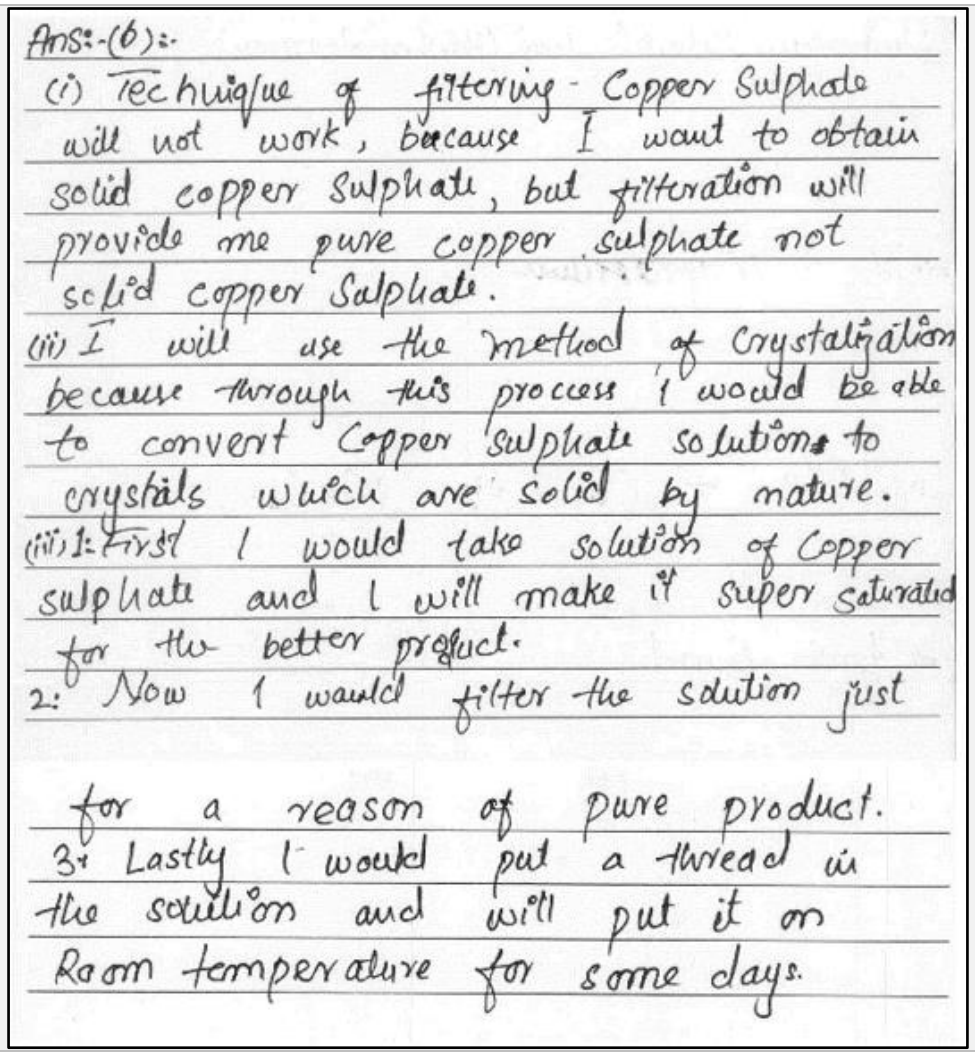
Image of Better Response	 (i) the technique of filtering copper (II) sulphate will not work because the whole solution will pass from the filter paper because of its homogeneus composition and we will find nothing in solid form. (ii) I will like to use crystallization method because by crystallization method we will get crystals of $CuSo_4$ in solid state. (iii) The steps of crystallization are described below. (1) First of all we'll take the saturated solution of $CuSo_4$ and convert it to supersaturated sdution by heating. (2) Then; when we observe the maximum concentration level of solution then we'll stop heating it and keep it to cool. 3) Then, some particles will settle down in the bottom of the containee; now we'll filtersate it from a filter paper; the homogeneus sdution will pass from it while the crystals formed of $CuSo_4$ will remain on the surface of filter paper.
Description of Weaker Responses	In part 'i', weaker responses exhibited a lack of critical thinking and reasoning skills and failed to describe the inapplicability of filtering to separate copper sulphate from water. They often provided incorrect reasons, such as copper being soluble in water, without linking it to the inability to use the filtering technique. In part 'ii', most candidates correctly identified the methods but failed to justify their identification. In part 'iii', weaker responses provided inaccurate steps for the separation technique, showing a lack of understanding of the process.

Image of Weaker Response	

Ans:-(6):-
(i) Technique of filtering - Copper Sulphate will not work, because I want to obtain solid copper Sulphate, but filteration will provide me pure copper sulphate not solid copper Sulphate.
(ii) I will use the method of Crystalization because through this process I would be able to convert Copper Sulphate solutions to crystals which are solid by nature.
(iii) 1:- First I would take solution of Copper sulphate and I will make it super saturated for the better product.
2:- Now I would filter the solution just for a reason of pure product.
3:- Lastly I would put a thread in the solution and will put it on Room temperature for some days.

Suggestions for improvement (Highlight all that apply)

How to Approach SLO	Pedagogy Used for that SLO	Assessment Strategies
• Understand the expectations of the command words • Look at the cognitive level • Identify the content that is required to answer that question (both in terms of understanding of concepts and any skills that may be required like analysing or evaluating) • Go through the past paper questions on that particular concept • Refer to the resource guide for extra resources	• 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 improve critical thinking and reasoning skills, candidates should be encouraged to analyse the properties of substances involved in separation processes and determine the most appropriate techniques based on solubility and other factors. Teachers can provide more examples and case studies to help candidates apply their knowledge to practical scenarios. To strengthen their understanding of separation techniques, candidates can engage in hands-on experiments or virtual simulations to witness the processes in action. Encouraging candidates to discuss their thought processes and reasoning during problem-solving exercises can also promote deeper understanding and enhance their overall performance.

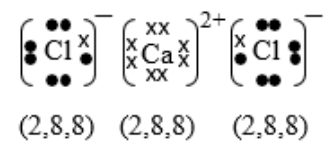
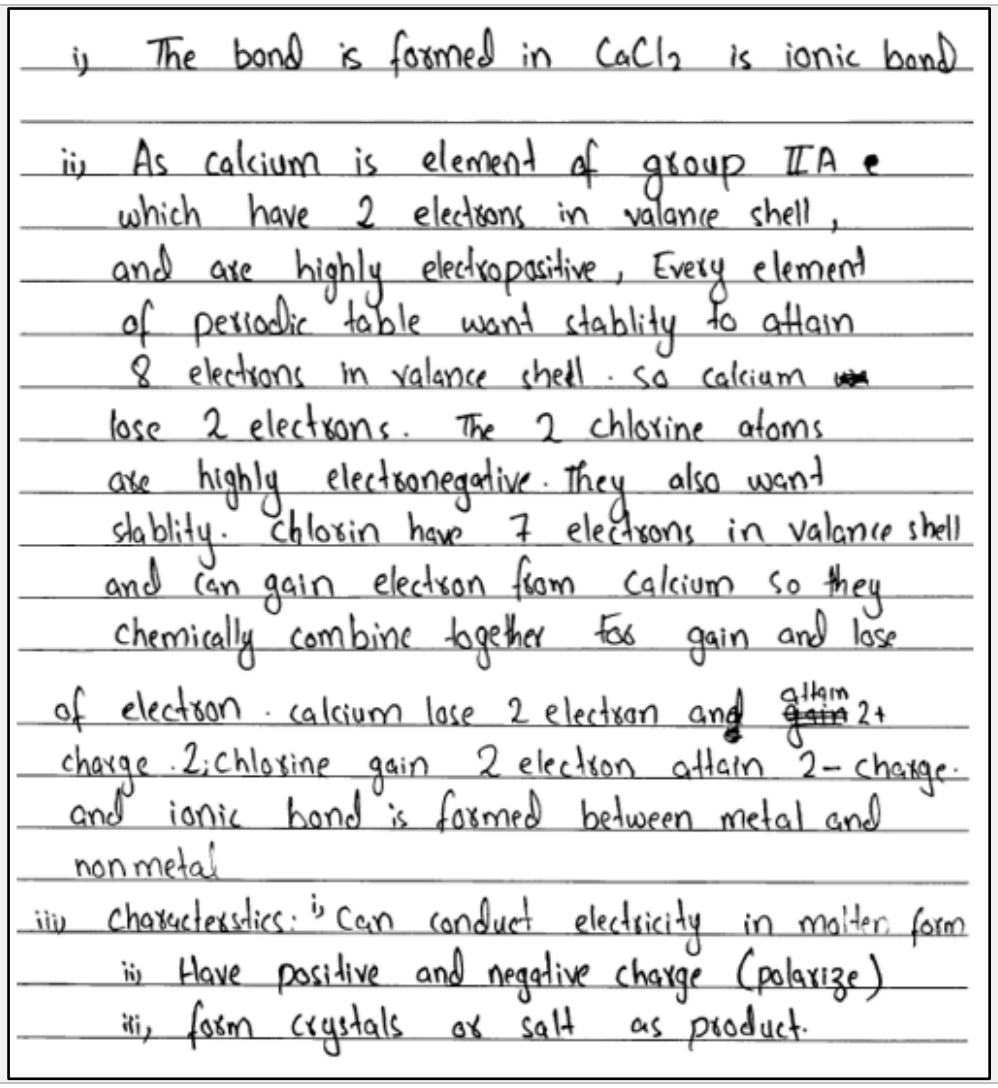
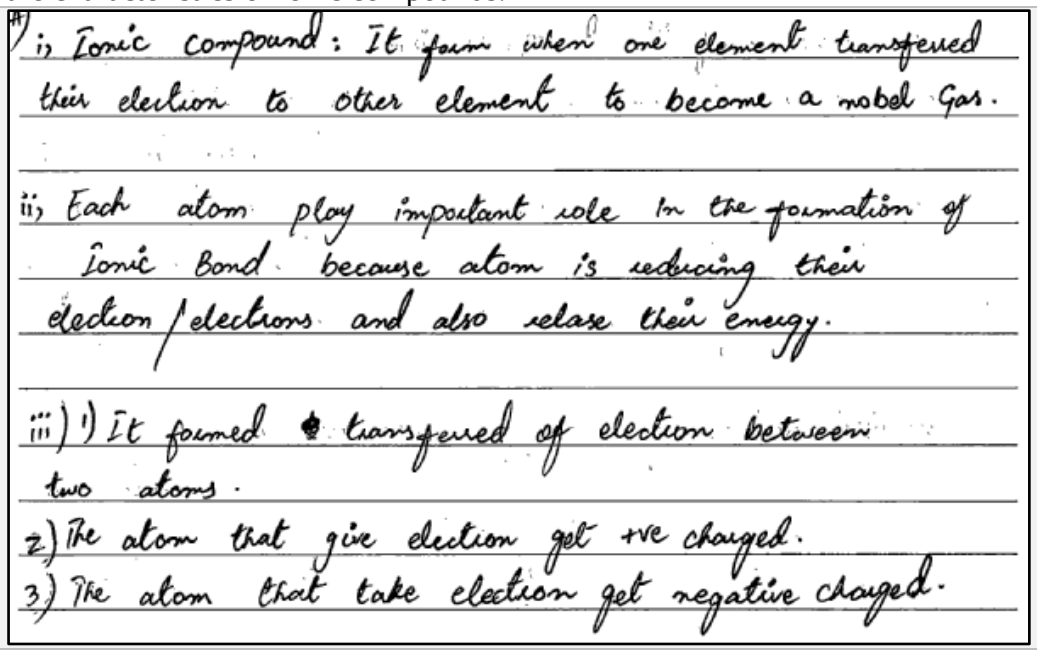
Question No. 6a	
Question Text	Consider the given dot and cross structure of a compound.  (2,8,8) (2,8,8) (2,8,8) With reference to the given dot and cross structure, i. identify the type of bond that exists in it. ii. describe the role of each atom in the formation of the bond identified in part i. iii. write any THREE general characteristics of such types of compounds.
SLO No.	4.2.4 (4.2.1)
SLO Text	Describe the characteristics of ionic compounds; (describe the formation of an ionic bond.)
Max Marks	6
Cognitive Level	U
Checking Hints	i. 1 mark for the identification of ionic bond ii. 1 mark for the role of each atom (2 required) iii. 1 mark for each correct characteristic of an ionic compound (any 3 required)
Overall Performance	Overall, candidates performed well in part 'i' by correctly identifying the type of chemical bonding in the given figure as ionic. Weaker responses, however, struggled to identify the type of bond correctly, often predicting covalent bonding. In part 'ii', they failed to explain the correct electron transfer in the formation of ions and lacked knowledge of the characteristics of ionic compounds. To improve, candidates should focus on the main concepts of electron transfer in ionic bonding and sharing in covalent bonding.
Description of Better Responses	Better responses accurately identified the type of chemical bonding as ionic in part 'i'. In part 'ii', candidates provided a clear description of the electron transfer, forming Ca^{+2} and $2Cl^{-1}$ ions. Similarly, in part 'iii', these responses drafted accurate general characteristics of ionic compounds, such as crystalline structure, electrical conductance, high melting and boiling points, and solubility in polar solvents like water.

Image of Better Response	 i) The bond is formed in $CaCl_2$ is ionic bond ii) As calcium is element of group IIA which have 2 electrons in valance shell, and are highly electropositive, Every element of periodic table want stablity to attain 8 electrons in valance shell. so calcium lose 2 electrons. The 2 chlorine atoms are highly electronegative. They also want stablity. Chlorin have 7 electrons in valance shell and can gain electron from calcium so they chemically combine together ~~for~~ gain and lose of electron. calcium lose 2 electron and attain 2+ charge. 2 chlorine gain 2 electron attain 2- charge. and ionic bond is formed between metal and non metal iii) characterstics: i) Can conduct electricity in molten form ii) Have positive and negative charge (polarize) iii) form crystals or salt as product.
Description of Weaker Responses	Weaker responses struggled to identify the correct type of bond, often predicting covalent bonding instead of ionic bonding. In part 'ii', candidates failed to describe the appropriate electron transfer for the formation of ions, and their responses mostly revolved around the sharing of electrons to form single covalent bonds. Additionally, they lacked knowledge of the characteristics of ionic compounds.
Image of Weaker Response	 #) i) Ionic compound: It form when one element transfered their election to other element to become a nobel Gas. ii) Each atom play important role in the formation of Ionic Bond because atom is reducing their election/elections and also relase their energy. iii) 1) It formed transfered of election between two atoms. 2) The atom that give election get +ve charged. 3) The atom that take election get negative charged.

Suggestions for improvement (Highlight all that apply)

How to Approach SLO	Pedagogy Used for that SLO	Assessment Strategies
• Understand the expectations of the command words • Look at the cognitive level • Identify the content that is required to answer that question (both in terms of understanding of concepts and any skills that may be required like analysing or evaluating) • Go through the past paper questions on that particular concept • Refer to the resource guide for extra resources	• 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 improve, candidates should be encouraged to study the concept of ionic bonding in-depth, emphasise the transfer of electrons from one atom to another to form ions with opposite charges. Teachers can provide more examples and visual aids to illustrate the process of electron transfer in ionic bonding. Furthermore, candidates should be guided to comprehend the unique characteristics of ionic compounds, such as their crystalline structure, solubility in water, and electrical conductance in solution or molten form. Hands-on activities or demonstrations involving ionic compounds can help solidify their understanding of these concepts. Providing practice exercises that require the identification of bonding types and characteristics of compounds will also be beneficial.

Question No. 6b	
Question Text	i. Define the term, 'electrolysis'. ii. Describe the electrolysis of concentrated sodium chloride solution (brine). Support your answer by writing chemical equations for reactions occurring at the cathode and the anode of the electrolytic cell.
SLO No.	7.5.2
SLO Text	Describe the manufacturing of sodium hydroxide from aqueous solution of NaCl.
Max Marks	6
Cognitive Level	U
Checking Hints	i. 1 mark for the definition ii. 1 mark for the reduction of H^+ cation/ chemical equation 1 mark for the formation of hydrogen gas at the cathode 1 mark for the oxidation of Cl^- anions/ chemical equation 1 mark for the formation of chlorine gas at the anode 1 mark for the combination of sodium and hydroxide ions to form a sodium hydroxide solution.
Overall Performance	The candidates' overall performance was assessed, taking note of their responses in defining electrolysis and explaining the stepwise process of electrolysis of concentrated sodium chloride solution (brine). Most candidates drafted the response in an appropriate way and

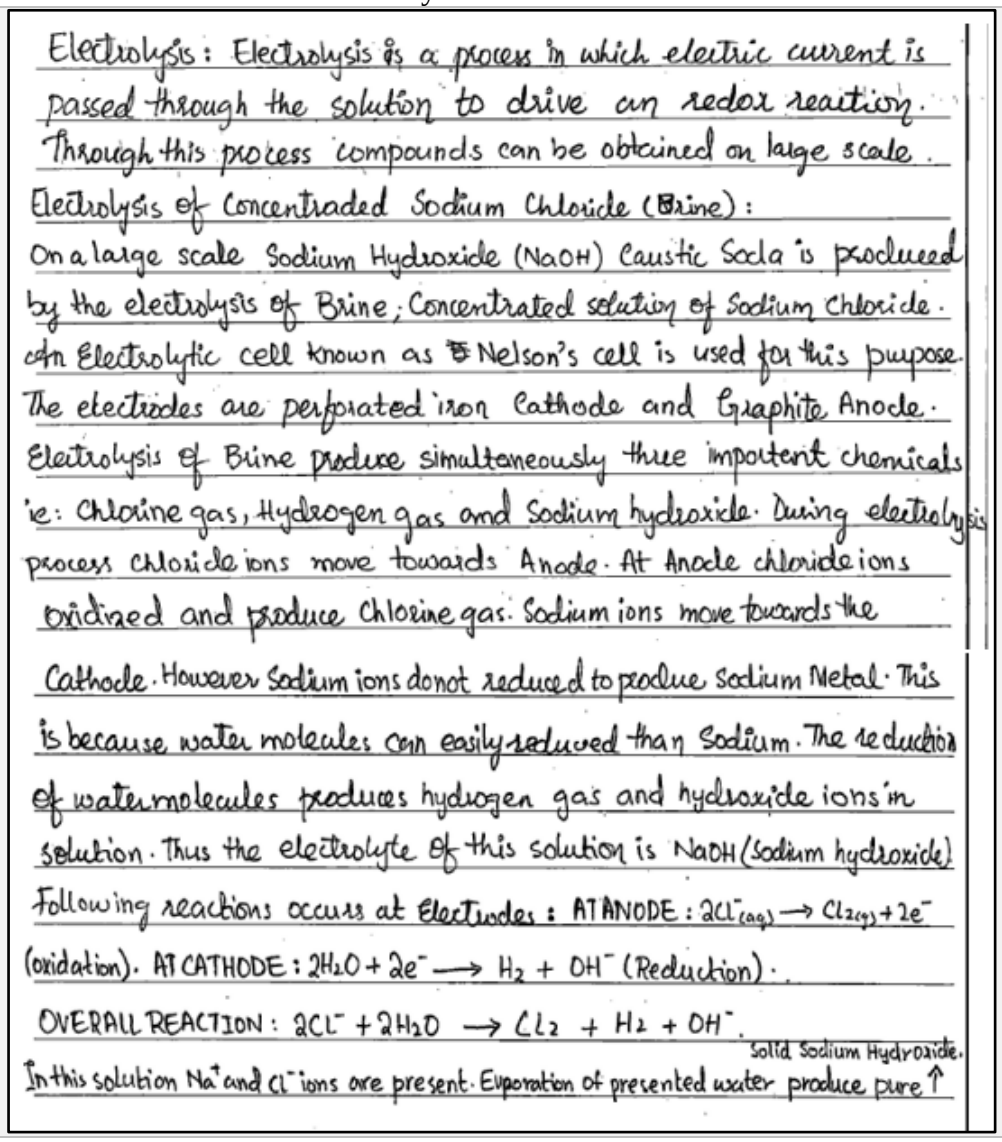
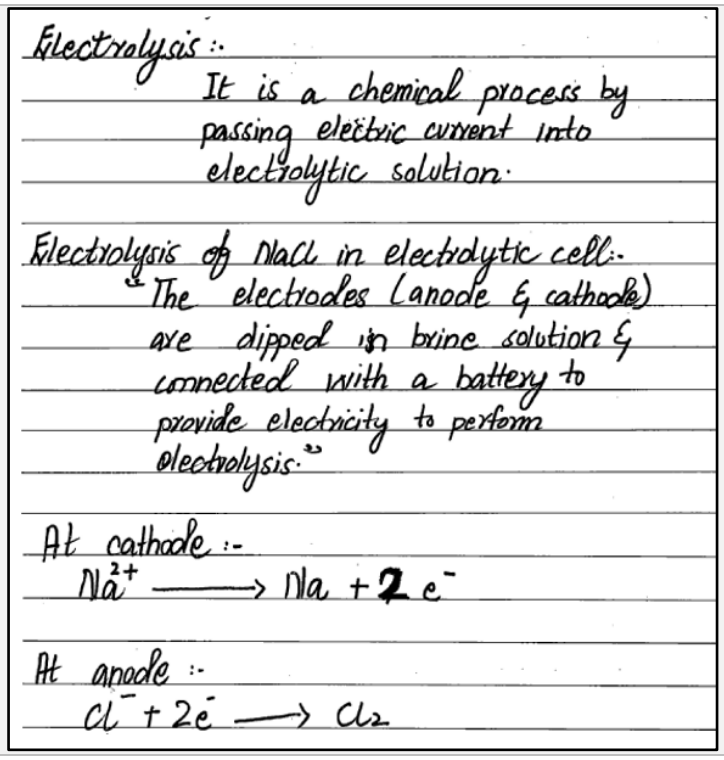
	remained successful in defining electrolysis and anodic and cathodic reactions that occur in electrolytic cells. However, a few candidates got confused in the electrolysis of molten sodium chloride.
Description of Better Responses	In part 'i', better responses accurately defined electrolysis as the decomposition of an electrolyte through the passage of electricity or a technique using direct electric current to drive a non-spontaneous chemical reaction. In part 'ii', candidates provided a detailed description of the electrolysis of brine, including the discharge of hydrogen ions at the cathode to form hydrogen gas $2H^+_{(aq)} + 2e^- \rightarrow H_{2(g)}$, the discharge of chloride ions at the anode to form chlorine gas $2Cl^-_{(aq)} \rightarrow Cl_{2(g)} + 2e^-$, and the formation of sodium hydroxide solution from sodium ions and hydroxide ions.
Image of Better Response	
Description of Weaker Response*	Weaker responses lacked a clear definition of electrolysis. For instance, they wrote 'it is a chemical process by passing an electric current into electrolytic solution' and were unable to describe the stepwise process of electrolysis of brine rather they mentioned the stages of electrolysis of molten sodium chloride via Down's cell. They struggled to describe the discharge of ions at the cathode and anode, as well as the formation of sodium hydroxide solution as a byproduct as they did not mention the chemical reaction of water and removal of hydrogen gas.

Image of Weaker Response	

Suggestions for improvement (Highlight all that apply)

How to Approach SLO	Pedagogy Used for that SLO	Assessment Strategies
• Understand the expectations of the command words • Look at the cognitive level • Identify the content that is required to answer that question (both in terms of understanding of concepts and any skills that may be required like analysing or evaluating) • Go through the past paper questions on that particular concept • Refer to the resource guide for extra resources	• 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 improve, candidates should be encouraged to study the concept of electrolysis in detail and understand the significance of using electric current to drive chemical reactions. Teachers can provide more examples and practical applications of electrolysis to make the concept more relatable. Improvement can be achieved through a deeper comprehension of the concept and practice in articulating the process effectively. Furthermore, candidates should practice describing the stepwise process of electrolysis in a coherent and systematic manner. Interactive demonstrations or laboratory experiments related to electrolysis can also help reinforce the concept and enhance understanding. Additionally, providing opportunities for discussions and Q&A sessions on electrolysis will enable candidates to clarify their doubts and solidify their knowledge.

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, students 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, students 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 the fish and bone technique to teach about the human skeletal system. 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, students 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 students' interest and understanding of space.

Pedagogy: Think, Pair, and Share
Description: A collaborative learning technique where students 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. Students 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 students 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. Students 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.)

Acknowledgements

The Aga Khan University Examination Board (AKU-EB) acknowledges with gratitude the invaluable contributions of all the dedicated individuals who have played a pivotal role in the development of the Chemistry SSC-I E-Marking Notes.

We extend our sincere appreciation to Ms Uroosa Aslam, Specialist in Chemistry at AKU-EB, for taking subject lead during the entire process of e-marking.

We particularly thank to Ms Saba Gul, BVS Parsi High School, Karachi, for evaluating each question's performances, delineating strengths and weaknesses in candidates' responses, and highlighting instructional approaches along with recommendations for better performance.

Additionally, we express our gratitude to the esteemed team of reviewers for their constructive feedback on overall performance, better and weaker responses, and validating teaching pedagogies along with suggestions for improvement.

These contributors include:

• Dr Sumera Anjum, Lead Specialist, Curriculum and Examination Development, AKU-EB

• Rabia Nisar, Specialist, Assessment, AKU-EB

• Shahneel Jawaid, Specialist, Curriculum and Examination Development, AKU-EB

• Munira Muhammad, Lead Specialist, Assessment, AKU-EB

• Zain Muluk, Manager, Examination Development, AKU-EB

• Raabia Hirani, Manager, Curriculum Development, AKU-EB

• Ali Aslam Bijani, Manager, Teacher Support, AKU-EB

• Dr Shehzad Jeeva, CEO, AKU-EB