آغا خان یونیورسٹی ایگزامینیشن بورڈ
AGA KHAN UNIVERSITY EXAMINATION BOARD

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

Introduction

This document has been produced for the teachers and candidates of the Secondary School Certificate (SSC) Part II Chemistry. It contains comments on candidates' responses to the 2025 SSC-II 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 examples 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 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

Most candidates demonstrated a thorough understanding of specific concepts and provided effective responses. It is appreciated that candidates' responses were well-structured in chronological order, based on the sub-parts of the question, while the Maintenance of a clear division between the designated sections of CRQs and ERQs was meticulously taken into consideration. They excelled in areas such as identifying the meaning of a reversible reaction symbol and a common functional group in fats and oils, i.e., ester. Additionally, candidates were able to classify organic compounds based on their structures. A significant number of candidates also identified and described metallurgical operations. Nevertheless, teachers should concentrate on the following content and provide candidates with more drills and practice to foster a solid understanding.

- Reason behind each factor affecting the equilibrium

- Classification of organic compounds as acyclic and aromatic
- Recognition of the purpose of the steps taken during water treatment
- Boiling points of substances, regardless of their physical states
- Writing chemical formulae and balancing chemical equations

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	Consider the given reaction at equilibrium and answer the following questions. $CaCO_{3(s)} \rightleftharpoons CaO_{(s)} + CO_{2(g)}$ ($\Delta H = 178.3$ kJ mol^{-1}) a. What does the symbol $\rightleftharpoons$ mean? b. Predict the effect on the given equilibrium if the system experiences the following conditions. **S. No.** / **Condition** / **Reason** i. Increasing temperature / / ii. Increasing pressure / / iii. Decreasing carbon dioxide concentration / /
SLO No.	9.3.7, 9.1.3
SLO Text	Determine the effect of catalyst, temperature, pressure and concentration on a reversible reaction at equilibrium. Show both forward and reverse reactions using chemical equations;
Max Marks	4
Cognitive Level	A*
Checking Hints	a. 1 mark for the correct meaning of the symbol b. 1 mark for predicting the correct effect in each case (3 required)
Overall Performance	Candidates showed a significant understanding of the symbol given in the equation. However, some candidates displayed confusion between reversible and reverse reactions and incorrectly associated factors affecting the rate of reversible reactions with both forward and reverse reactions.
Description of Better Responses	In the *better responses*, a considerable number of candidates correctly identified the double-headed or two half-headed opposite arrows as indicating a reversible reaction in the first part of the question. They recognised that the chemical equation involved both forward and reverse reactions. Many candidates responded with the one-word answer 'reversible reaction', while others explained that the arrows represented both forward and reverse processes. A few candidates further demonstrated their understanding by rewriting the equations using single-headed arrows in opposite directions to indicate the clarity of the concept.

Nested table from the Question Text:

S. No.	Condition	Reason
i.	Increasing temperature	
ii.	Increasing pressure	
iii.	Decreasing carbon dioxide concentration	

In part (i) of section (b), candidates interpreted the positive enthalpy value correctly, recognising that the given reaction was endothermic. Based on this, they showed a sound conceptual understanding of how temperature affects chemical equilibrium. They accurately stated that the addition of heat to the system would shift the reaction in the forward direction, towards the products or from left to right.

In part (ii) of section (b), candidates effectively explained that applying pressure would primarily affect carbon dioxide, as it is the only gaseous component in the reaction mixture. Given this scenario, they correctly stated that the equilibrium would shift in the reverse direction—towards the side with fewer moles of gas, i.e., the reactants' side or from right to left.

In part (iii), *better responses* reflected a clear understanding that decreasing a product concentration by removing it from the reaction mixture would shift the equilibrium towards the forward direction, favouring the formation of more products, or from left to right.

Images of Better Response

Part 'a'

$\rightleftharpoons$ mean that the reaction is reversible.

Part 'b'

Image i

S. No.	Condition	Effect
i.	Increasing temperature	Reaction will shift on right.
ii.	Increasing pressure	Reaction will shift on Left.
iii.	Decreasing carbon dioxide concentration	Reaction will shift on right.

Image ii

S. No.	Condition	Effect
i.	Increasing temperature	Increasing temperature will favour forward direction. As the forward reaction is endothermic, so increasing temperature will shift the equilibrium towards right (forward direction).
ii.	Increasing pressure	Increasing pressure will favour (reverse) reaction. As we have less number of moles in left side so according to le-chetlieav the system tends to adjust itself by shifting the equilibrim to the left. Equilibrium will be shifted towards Reverse direction.
iii.	Decreasing carbon dioxide concentration	If CO_2 concentration is decreased it will favour forward direction. Equilibrium will be shifted towards forward direction.

Description of Weaker Responses

In *weaker responses* to section (a), candidates often interpreted the double-headed arrow symbol as representing terms such as equilibrium, equilibrium state, dynamic equilibrium, or the rates of forward and reverse reactions, including equal rates of both. These responses reflected a limited understanding of the actual implication of the symbol, which denotes the reversibility of the reaction. Candidates demonstrating these weaker responses also showed a lack of awareness regarding how changes in conditions affect chemical equilibrium.

In section (b), many candidates presented counterstatements in response to one or more of the applied conditions but failed to justify the correct effect in any case.

Moreover, in part (i) of section (b), several candidates incorrectly stated that the reaction would shift to the endothermic side without clarifying which direction (forward or reverse) was endothermic. They also incorrectly claimed that an increase in temperature would shift the equilibrium to the reactant side/ reverse direction/ from right to left, contrary to the correct direction.

Similarly, in part (ii), most candidates showed a misconception by stating that pressure would have no effect, reasoning that gaseous substances were not present on both sides of the equation. This indicated a misunderstanding of the role of gaseous components in pressure-based equilibrium shifts.

Additionally, in part (iii), candidates incorrectly interpreted that decreasing the concentration of carbon dioxide would shift the equilibrium to the left/ reactant side/ in the reverse direction, which is the opposite of the correct effect.

Images of Weaker Response

Part 'a'

This symbol means that reaction is in equilibrium state (Rate of forward reaction = Rate of reverse reaction).

Part 'b'

Image i

S. No.	Condition	Effect
i.	Increasing temperature	Shifts in reverse direction
ii.	Increasing pressure	Shifts the equilibrium shifts in forward direction
iii.	Decreasing carbon dioxide concentration	will increase the Concentration of H_2O.

Image ii

S. No.	Condition	Effect
i.	Increasing temperature	By increasing temperature the reaction will be an endothermic reaction and will go towards reverse direction.
ii.	Increasing pressure	If increasing pressure on product side then reaction will go towards reverse direction but if we increase pressure on reactant side the pressure will be equal on both sides.
iii.	Decreasing carbon dioxide concentration	If we decrease CO_2 concentration then reaction will go towards forward direction.

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

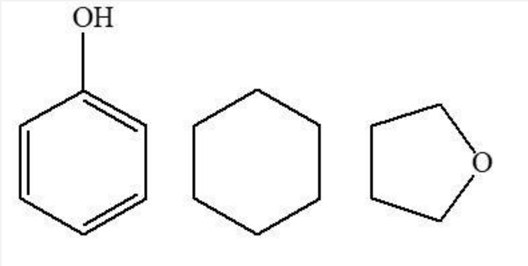
Any Additional Suggestions: Teachers are encouraged to utilise the pictorial demonstration provided in the recommended Grade X textbook for this particular reaction and use simulations to visually reinforce student understanding regarding equilibrium shifts.

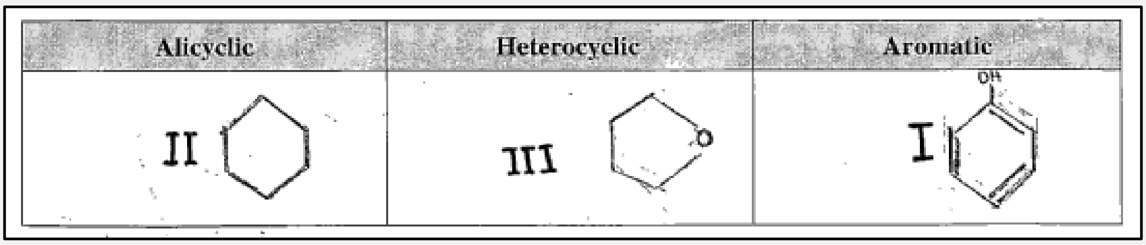
Moreover, it is essential to clearly explain the concept of how different factors influence the equilibrium state. For instance, in the case of an endothermic reaction, heat acts as a reactant; if heat is removed or not supplied, the reaction will proceed in the opposite direction, as the reverse reaction would release the heat.

Teachers should also emphasise that changes applied to a system at equilibrium, such as temperature or pressure, affect the entire system uniformly and cannot be applied to just one side of the reaction.

Additionally, the effect of pressure should be discussed in the context of …..: pressure primarily influences fluids (gases and liquids), and it is not necessary for gaseous components to be present on both sides of the reaction equation for a pressure-related shift in equilibrium to occur.

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

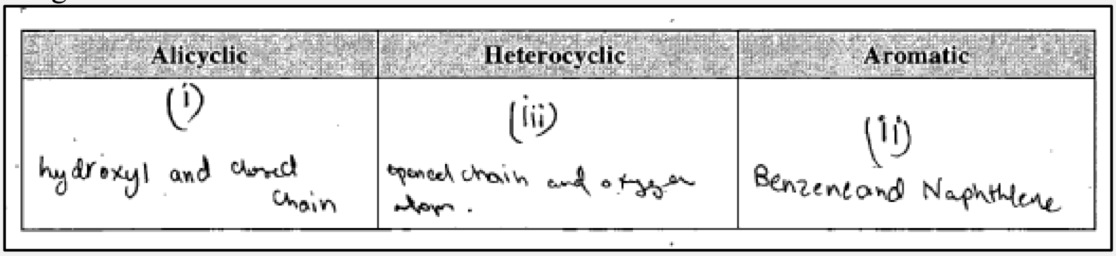
<table>
<tr><th colspan="2">Question No. 2</th></tr>
<tr><td>Question Text</td><td>Consider the following structures of organic compounds.

I II III

Classify each compound in the given table based on its structure.
<table>
<tr><th>Alicyclic</th><th>Heterocyclic</th><th>Aromatic</th></tr>
<tr><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>SLO No.</td><td>11.2.1</td></tr>
<tr><td>SLO Text</td><td>Classify organic compounds into acyclic and cyclic compounds with examples;</td></tr>
<tr><td>Max Marks</td><td>3</td></tr>
<tr><td>Cognitive Level</td><td>U</td></tr>
<tr><td>Checking Hints</td><td>1 mark for each correct classification (3 required)</td></tr>
<tr><td>Overall Performance</td><td>Overall, a significant number of candidates successfully classified the given structures and demonstrated the ability to differentiate between the cyclic compounds presented in the question. However, the most common error observed in candidates' responses was the inability to distinguish between benzenoid and non-benzenoid hexagonal structures.</td></tr>
<tr><td>Description of Better Responses</td><td>Better responses accurately identified the presence of aromaticity by recognising the alternating double bonds within the hexagonal cyclic structure of the benzene ring, correctly classifying it as an aromatic compound. Some candidates went a step further by naming the compound as phenol and appropriately categorising Compound I under the correct heading. Similarly, Compound II, which is a non-benzenoid cyclohexane structure, was correctly placed under the alicyclic compounds category. The five-membered ring containing an oxygen atom was accurately identified as a heterocyclic compound due to the presence of a heteroatom.
These responses included those candidates who either redrew the correct structure or indicated the classification by providing accurate numbering or placement under the appropriate sections.</td></tr>
<tr><td>Image of Better Response</td><td>
</td></tr>
</table>

Description of Weaker Responses	*Weaker responses* frequently reflected misconceptions in distinguishing whether the hexagonal six-membered ring structure in compounds I and II were aromatic or alicyclic. Candidates were also confused about the oxygen atom of the phenol ring as a heteroatom and placed it in the heterocyclic section. Additionally, some candidates incorrectly provided details about functional groups in the designated boxes instead of classifying the given structures. This indicated a lack of comprehension of the command word and the actual requirement of the question. Furthermore, a few responses grouped two compounds in a single classification box—for example, pairing Compounds I and II, II and III, or III and I—demonstrating a complete lack of conceptual understanding.

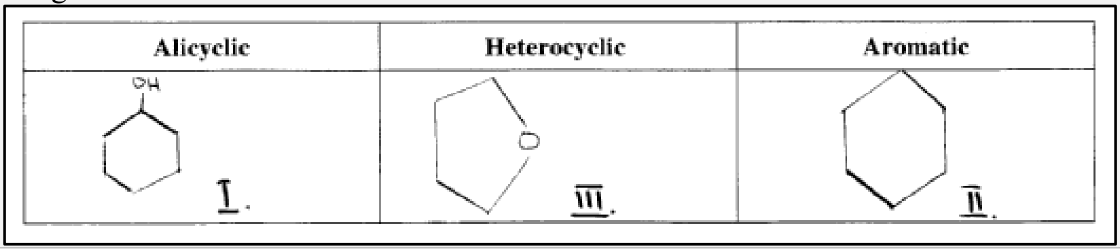
Images of Weaker Response

Image i



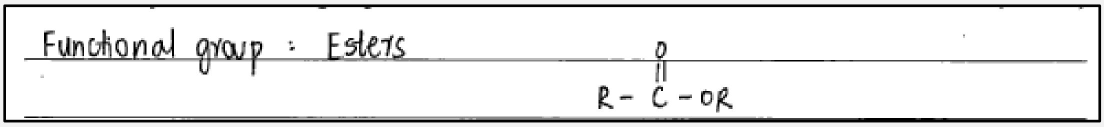
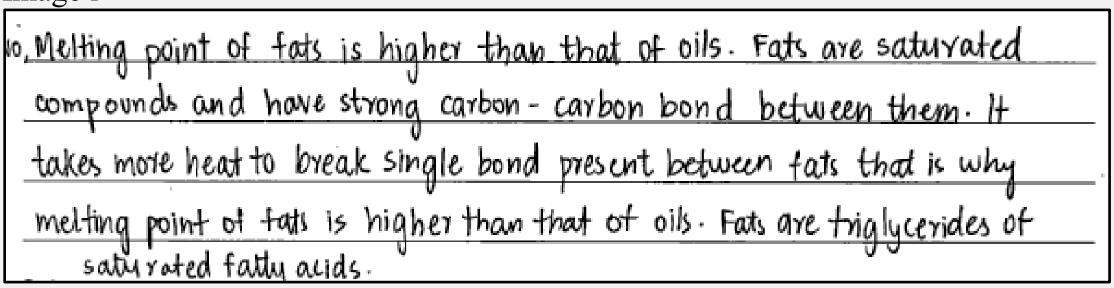
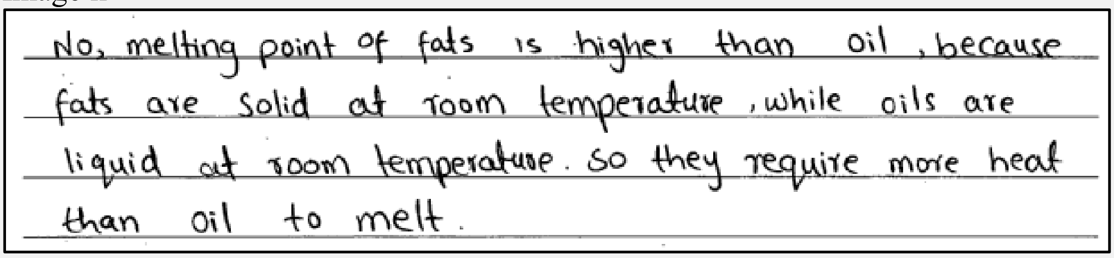
Alicyclic	Heterocyclic	Aromatic
(i) hydroxyl and closed chain	(iii) opened chain and oxygen atom.	(ii) Benzene and Naphthlene

Image ii



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: Teachers can use flash cards to enable students to identify different organic structures and classify them.		

Question No. 3	
Question Text	a. Identify the functional group common in both, fats and oils. b. Is the melting point of fats lower than that of oils? Provide a reason for your response.
SLO No.	13.4.2
SLO Text	Differentiate between fats and oil;
Max Marks	3
Cognitive Level	U
Checking Hints	a. 1 mark for identifying the correct functional group b. 1 mark for writing about the higher melting points of fats 1 mark for the correct reason
Overall Performance	Overall, the candidates showed a befitting performance on this question. However, most of them struggled to justify their response with a suitable reason in part b.
Description of Better Responses	In part (a), *better responses* identified the functional group common to both fats and oils as the ester group, represented as RCOOR' or RCO_2R'. A few candidates also referred to these as triglycerides of fatty acids, which was also accepted as a correct response. In part (b), most candidates disagreed with the given statement by responding with 'NO' or by rephrasing it correctly, stating that the melting point of fats is higher than that of oils, or conversely, that oils have a lower melting point than fats. To justify their answers, candidates explained that fats are denser, have molecules that are more closely packed, are solid at room temperature, contain more hydrogen atoms (indicating saturation), and exhibit stronger intermolecular forces. They specifically noted that saturated fatty acids allow molecules to pack tightly, leading to stronger Van der Waals forces and a higher melting point. In contrast, oils consist mainly of unsaturated fatty acids, which contain one or more double or triple bonds. This unsaturation introduces kinks/ bends in the hydrocarbon chains, preventing close packing, resulting in weaker intermolecular forces, consequently, a lower melting point. Some candidates also correctly pointed out that since fats are solids and oils are liquids at room temperature, fats require a higher temperature to overcome the stronger intermolecular interactions.
Images of Better Response	Part 'a'  Functional group : Esters R-C(=O)-OR Part 'b' Image i  No, Melting point of fats is higher than that of oils. Fats are saturated compounds and have strong carbon-carbon bond between them. It takes more heat to break single bond present between fats that is why melting point of fats is higher than that of oils. Fats are triglycerides of saturated fatty acids. Image ii  No, melting point of fats is higher than oil, because fats are solid at room temperature, while oils are liquid at room temperature. So they require more heat than oil to melt.

Description of Weaker Responses	In part (a), *weaker responses* revealed confusion in identifying the correct functional group. Candidates incorrectly listed ketones, ethers, alkynes, alkenes, carbohydrates, proteins, vitamins, amino acids, macromolecules and even basic elements such as carbon, hydrogen, and oxygen as functional groups. Some responses also referred to the sources of fats and oils instead of their functional groups, reflecting a fundamental misunderstanding of the concept. A significant number of candidates mistakenly identified glycerol or alcohols as the common functional group, which further demonstrated conceptual gaps. In part (b), candidates typically made one of three types of errors: 1. They agreed with the given statement that the melting point of fats lower than that of oils, but provided a correct justification, indicating a contradiction between their reasoning and final answer. 2. They disagreed with the given statement but supported their answer with incorrect and contradictory reasoning. 3. They agreed with the given statement and then justified it using flawed or incorrect chemistry about fats and oils, such as stating that oils have stronger intermolecular forces or are more saturated, which led to the mistaken conclusion that oils have a higher melting point for the wrong reasons.
Images of Weaker Response	Part 'a' Image i The Functional Group common in fats & oil are they both are macromolecule consist of amino acid. Image ii fats are comming from animals oils are coming from plants Part 'b' Image i Melting point of fats is lower than the oil because oil is the saturated compound & which is highly saturated we have to give heat of 165° to oil so it will become Ghee. Image ii Yes, melting point of fats is lower than that of oil because fats are saturated hydrocarbons having single bond between carbon atoms. While oil being unsaturated hydrocarbon have double bond. So it takes more heat energy to breakdown the double bond of oils, having higher M.P than fats.

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: Teachers should demonstrate the concept of melting and boiling points of various substances regardless of their physical states at room temperature and real-life scenarios. For instance, water is liquid at room temperature, but at 0°C it freezes, so the temperature at which a substance changes its phase is marked as its melting or freezing point. Likewise, gases have melting and boiling points even though they remain gaseous at room temperature; for example, liquid ammonia is used in many high-end desserts and swimming pools to create ambience.		

Question No. 4

Question Text

Write the purpose of each of the following processes involved in raw water treatment.

S. No.	Process	Purpose
i.	Passing raw water through the beds of sand and gravel	
ii.	Treatment of raw water with activated charcoal	
iii.	Addition of aluminium sulphate in raw water	

SLO No.	15.4.4
SLO Text	Compare the processes of raw water treatment and sewage treatment.
Max Marks	3
Cognitive Level	U
Checking Hints	1 mark for each purpose (3 required)
Overall Performance	The overall performance of candidates in this question was satisfactory. Few candidates were able to comprehend the key term, specifically, the purpose of the process. However, many candidates faced difficulty in clearly articulating the purpose and linking it appropriately to the name of the process, which affected the accuracy of their responses.
Description of Better Responses	In part (i), *better responses* accurately stated the purpose of passing raw water through beds of sand and gravel as the removal of fine solid particles. Some candidates used terms such as fine filtration to describe the process of eliminating small/ tiny dirt particles, which was also considered appropriate. In part (ii), candidates correctly identified that the addition of activated charcoal to raw water is intended to remove taste and odours or foul smells. In some cases, it was also accepted that charcoal removes colour from water by adsorbing colour-causing impurities and other contaminants, where present. In part (iii), *better responses* conveyed that the purpose of adding aluminium sulphate during water treatment is to clump together fine particles, describing the process as coagulation, flocculation, or the adhesion of suspended impurities into larger aggregates (sludge) that settle at the bottom. Some candidates effectively described this as the formation of a gelatinous mass with suspended impurities, dust particles, or bacteria that aids in their removal through sedimentation.

Image of Better Response

S. No.	Process	Purpose
i.	Passing raw water through the beds of sand and gravel	To filter the water and remove small and fine particles from it.
ii.	Treatment of raw water with activated charcoal	To remove bad tastes and evil smell.
iii.	Addition of aluminium sulphate in raw water	As a coagulant to stick all the suspended particles together.

<table>
<tr>
<td>Description of Weaker Responses</td>
<td>Weaker responses demonstrated a limited understanding of the specific purposes asked in each part of the question. In part (i), many candidates confused general filtration with fine filtration, failing to recognise the distinct role of sand and gravel beds in removing fine solid particles.
In part (ii), candidates frequently stated that the purpose of activated charcoal is to kill bacteria, reflecting a misconception and confusing this step with the chlorination process.
In part (iii), most responses inaccurately claimed that aluminium sulphate is used to remove water hardness or to kill pathogens, indicating a lack of clarity about its actual function.
Overall, weaker responses tended to rely on vague and repetitive statements, such as the purification of water, removal of impurities, or making water safe and clean for each part, which did not address the specific purposes required and resulted in a loss of marks.</td>
</tr>
<tr>
<td>Images of Weaker Response</td>
<td>Image i
<table>
<tr><th>S. No.</th><th>Process</th><th>Purpose</th></tr>
<tr><td>i.</td><td>Passing raw water through the beds of sand and gravel</td><td>to get the impurities out of raw water.</td></tr>
<tr><td>ii.</td><td>Treatment of raw water with activated charcoal</td><td>to kill the harmful stuff in hard water.</td></tr>
<tr><td>iii.</td><td>Addition of aluminium sulphate in raw water</td><td>to make the raw water softer</td></tr>
</table>
Image ii
<table>
<tr><th>S. No.</th><th>Process</th><th>Purpose</th></tr>
<tr><td>i.</td><td>Passing raw water through the beds of sand and gravel</td><td>Remove impurities like leaves sticks from raw water.</td></tr>
<tr><td>ii.</td><td>Treatment of raw water with activated charcoal</td><td>To coagulate the remaining impure substances for filtration</td></tr>
<tr><td>iii.</td><td>Addition of aluminium sulphate in raw water</td><td>To disinfectant the water or to kill pathogens and bacteria from it. and safe for drinking purpose.</td></tr>
</table>
</td>
</tr>
</table>

Suggestions for improvement (Highlight all that apply)

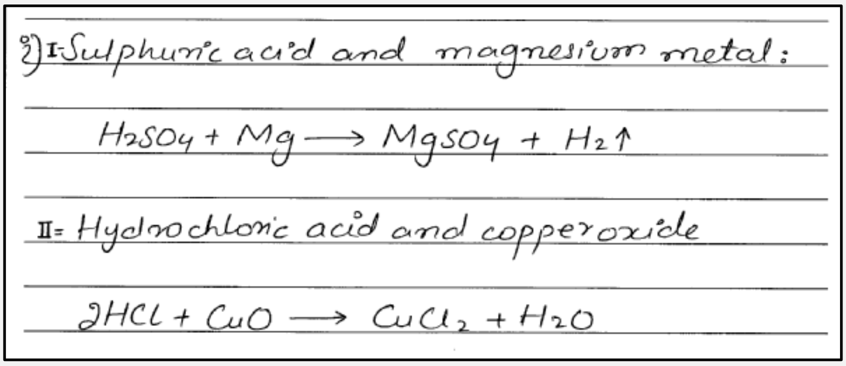
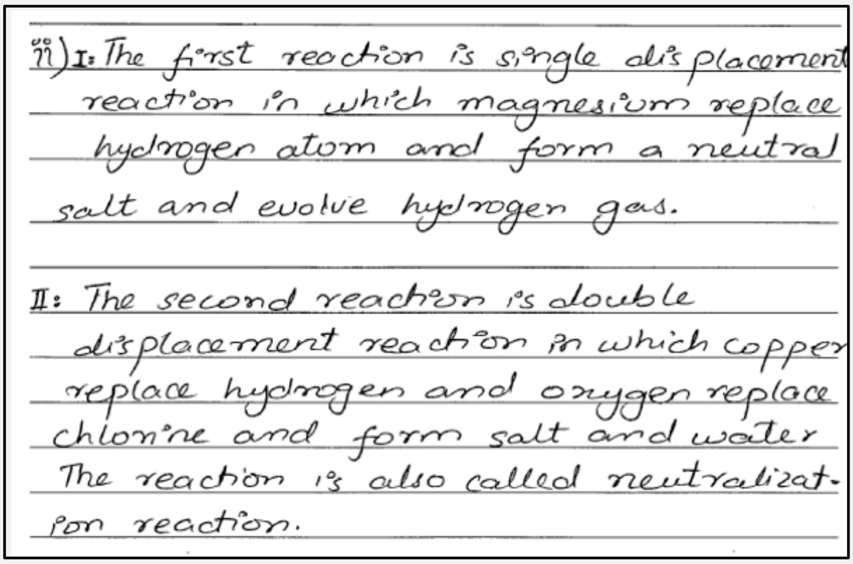
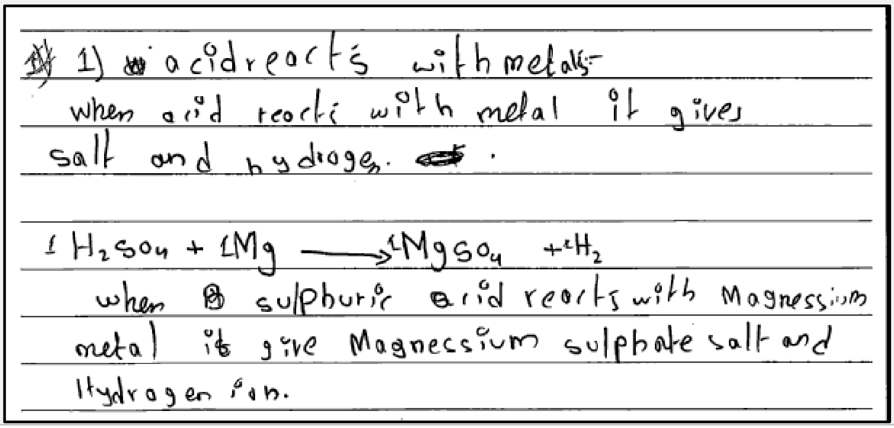
Maximising SLO Achievement	Pedagogy Used for that SLO	Assessment Strategies
• Identify the expectation of command words (use Command Word Guide) • Ensure the content is taught at the relevant cognitive level	• Story Board • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual Resources •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

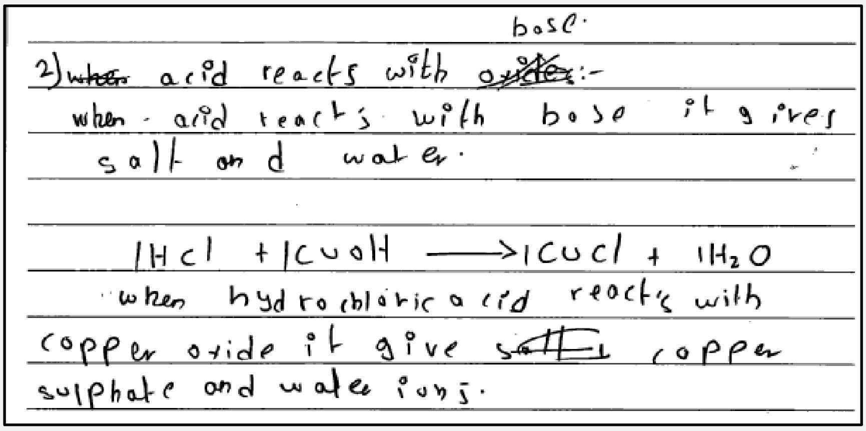
• Identify necessary content required (skills + concepts) • Review past paper questions on the concept Utilise the resource guide for additional materials	• Knowledge Platform videos • Questioning Technique (Socratic approach) Practical Demonstration	
Any Additional Suggestion:		

Extended Response Questions (ERQs)

Extended response questions offered a choice between parts 'a' and 'b'

Question No. 5a	
Question Text	i. Write balanced equations to show the chemical reactions between the following sets of reactants. I. Sulphuric acid and magnesium metal II. Hydrochloric acid and copper(II) oxide ii. Identify and describe the types of chemical reactions that each set of reactants undergoes in part 'i'.
SLO No.	10.7.3
SLO Text	Describe the methods of preparing soluble and insoluble salts;
Max Marks	6
Cognitive Level	U
Checking Hints	i. 1 mark for each balanced chemical equation (2 required) ii. 1 mark for identifying each type of reaction (2 required) 1 mark for describing each type of reaction (2 required – any ONE point for each)
Overall Performance	Most of the candidates attempted part (a) from the given choice. Overall, understanding of equation balancing and the identification of chemical reactions were the key elements on which the candidate's performance was based. Candidates who struggled with writing the correct chemical formula for copper(II) oxide were unable to fully meet the content requirements of the question.
Description of Better Responses	*Better responses* in part (I) of (i) demonstrated a clear and thorough understanding of formula writing and equation balancing. Candidates correctly wrote the formulas of the reactants and products, applying appropriate valencies. i.e., I. $H_2SO_{4(aq)} + Mg_{(s)} \rightarrow MgSO_{4(aq)} + H_{2(g)}$ In part (II) of (i), candidates accurately wrote the formula for copper(II) oxide, reflecting a sound understanding of oxidation states when writing chemical formulas. They also balanced the equation correctly by using a coefficient of 2 for HCl, ensuring the number of moles and atoms were equal on both sides. II. $2HCl_{(aq)} + CuO_{(s)} \rightarrow CuCl_{2(aq)} + H_2O_{(l)}$ In part (ii), *better responses* identified reaction (I) as a single displacement (or replacement) reaction and explained it appropriately, often referring to the example in part (i). Some candidates also used the term 'substitution' to describe the reaction and gave a precise explanation, stating that magnesium substitutes hydrogen in sulphuric acid to form a soluble salt, $MgSO_4$, with the evolution of H_2 gas indicated with an upward arrow (↑). Furthermore, for reaction (II), candidates correctly classified it as a double displacement (or double replacement) reaction. Many also noted the basic nature of copper(II) oxide as a metallic oxide/ showing the formation of $Cu(OH)_2$ first, and then appropriately referred to its reaction with HCl as a neutralisation process—a logically sound interpretation.

Images of Better Response	Part 'i'  i) I- Sulphuric acid and magnesium metal: $H_2SO_4 + Mg \rightarrow MgSO_4 + H_2\uparrow$ II- Hydrochloric acid and copperoxide $2HCl + CuO \rightarrow CuCl_2 + H_2O$ Part 'ii'  ii) I: The first reaction is single displacement reaction in which magnesium replace hydrogen atom and form a neutral salt and evolve hydrogen gas. II: The second reaction is double displacement reaction in which copper replace hydrogen and oxygen replace chlorine and form salt and water The reaction is also called neutralizat-ion reaction.
Description of Weaker Responses	*Weaker responses*, in part (I) of (i), revealed difficulties in formula writing and equation balancing. Furthermore, they mentioned H_2O instead of H_2 as a by-product. Particularly, in part (II) of (i), several candidates incorrectly wrote Cu_2O instead of CuO, indicating confusion in applying correct valencies or oxidation states while writing chemical formulas. Additionally, some responses included incorrect formulas such as CuOH and subsequently classified the reaction with HCl as a neutralisation reaction in part (ii), showing a lack of conceptual clarity. Those who mentioned the correct formula forgot to balance the second equation by applying the mole ratio. In part (ii), while some candidates attempted to describe the reactions using the word equations provided in the question, they were unable to correctly identify the reaction types or differentiate between methods for forming soluble and insoluble salts. This highlights a limited understanding of the reaction processes involved.
Images of Weaker Response	Part 'i'  1) acid reacts with metals- when acid reacts with metal it gives salt and hydrogen. $1 H_2SO_4 + 1Mg \rightarrow 1MgSO_4 + 1H_2$ when sulphuric acid reacts with Magnessium metal it give Magnecsium sulphate salt and Hydrogen ion.

	Part ‘ii’ 

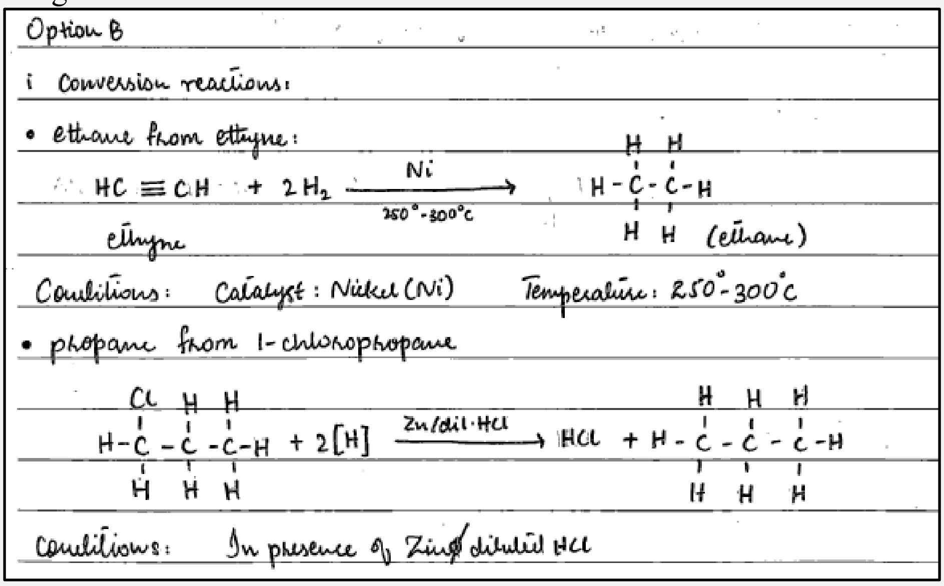
base·
2) ~~when~~ acid reacts with ~~oxide~~ :-
when acid reacts with base it gives salt and water.

$1HCl + 1CuOH \longrightarrow 1CuCl + 1H_2O$
when hydrochloric acid reacts with copper oxide it give ~~salt~~ copper sulphate and water ions.

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 Suggestions: Teachers are encouraged to provide targeted worksheets and incorporate interactive simulations to reinforce students’ skills in formula writing, equation balancing, and identifying reaction types. These tools can be used effectively for drill and practice, helping students internalise fundamental concepts through repeated application and visual engagement.		

Question No. 5b	
Question Text	Consider the given conversion reactions. • Ethane from ethyne (acetylene) • Propane from 1-chloropropane For each reaction, i. write a balanced chemical equation mentioning conditions where required. ii. identify the type of reaction for each conversion in part ‘i’.
SLO No.	12.5.4
SLO Text	Show the preparation of alkanes from hydrogenation of alkenes and alkynes and reduction of alkyl halides using chemical equations;
Max Marks	6
Cognitive Level	A
Checking Hints	i. 1 mark for each complete balanced equation (2 required) (Note: No mark will be awarded if candidates do not mention the reactants)

	1 mark for each condition (2 required) ii. 1 mark for correct identification of each reaction (2 required)
Overall Performance	A smaller number of the total candidature opted for this ERQ option. A few unique and insightful responses were also observed during the marking process, which will be highlighted in the subsequent sections. However, a commonly noted error was the inability to correctly identify the specific conditions required for the reactions.
Description of Better Responses	In the first reaction of part (i), *better responses* demonstrated a thorough and precise understanding of the conversion of ethyne (acetylene) into ethane. Candidates accurately depicted the structures using skeletal and condensed formulae, and in some instances, even molecular formulae were provided. While some did not explicitly show double or triple bonds, the responses were still credited due to the correct representation of hydrogen count in both reactant and product. They appropriately identified the reagent as hydrogen (H_2), correctly indicated the number of moles required (2 moles), and stated suitable reaction conditions such as nickel (Ni) at 200–300°C or platinum/ palladium (Pt/ Pd) at room temperature. The final product, ethane, was consistently named and represented correctly. In the second reaction of part (i), candidates accurately drew the structure of 1-chloropropane and correctly identified the reagent as nascent hydrogen [H], which is generated in-situ using Zn/HCl. They clearly understood that nascent hydrogen is short-lived and highly reactive, allowing effective reduction of the alkyl halide. Most responses depicted the product, propane $CH_3–CH_2–CH_3$, using either skeletal or condensed structural formulae, and correctly included the by-product, HCl. A particularly unique response stood out, in which a candidate proposed an alternative two-step synthetic route to reach the same final product. The candidate first performed a dehydrohalogenation of 1-chloropropane using alcoholic KOH to produce propene, along with KBr and H_2O as by-products, followed by the second step, the candidate conducted hydrogenation of propene to yield propane. This approach reflected advanced synthetic reasoning and higher-order thinking akin to that of a synthetic organic chemist—an exceptional and rare response demonstrating remarkable conceptual insight at grade X level. In part (ii), *better-performing* candidates correctly identified the first reaction as hydrogenation and the second as reduction. The candidate who proposed the alternative two-step synthesis accurately named the first step as dehydrohalogenation, though they missed labelling the second step as hydrogenation, which would have completed the justification of the strategy effectively.
Images of Better Response	Part i Image i  Image ii

<table>
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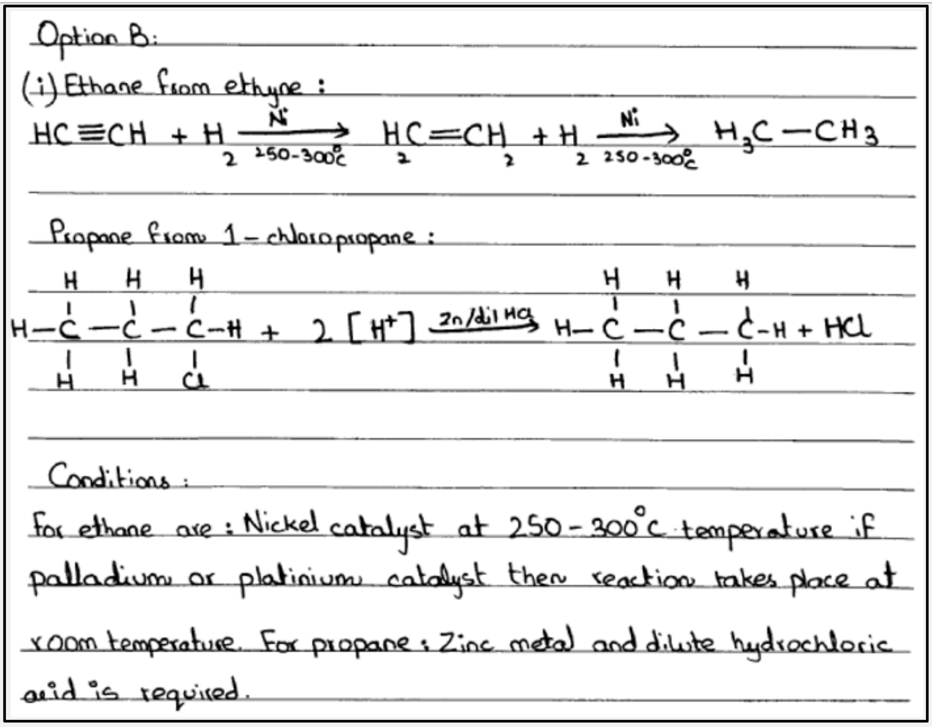


Option B:

(i) Ethane from ethyne:

$HC\equiv CH + H_2 \xrightarrow[250-300^\circ C]{Ni} H_2C=CH_2 + H_2 \xrightarrow[250-300^\circ C]{Ni} H_3C-CH_3$

Propane from 1-chloropropane:

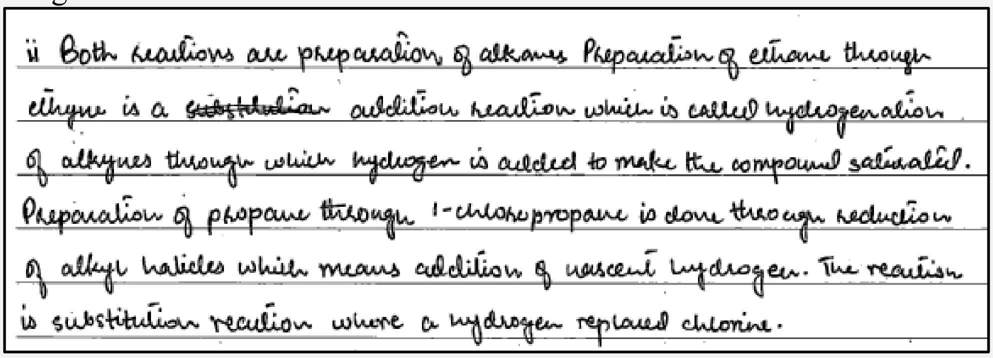
$CH_3-CH_2-CH_2Cl + 2[H^+] \xrightarrow{Zn/dil\ HCl} CH_3-CH_2-CH_3 + HCl$

Conditions:

For ethane are: Nickel catalyst at 250-300°C temperature if palladium or platinium catalyst then reaction takes place at room temperature. For propane: Zinc metal and dilute hydrochloric acid is required.

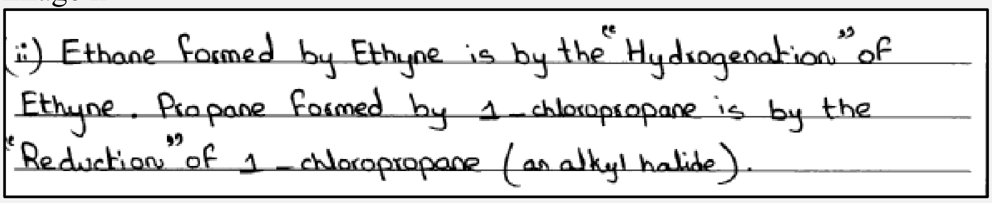
Part ii

Image i



ii Both reactions are preparation of alkanes Preparation of ethane through ethyne is a ~~substitution~~ addition reaction which is called hydrogenation of alkynes through which hydrogen is added to make the compound saturated. Preparation of propane through 1-chloropropane is done through reduction of alkyl halides which means addition of nascent hydrogen. The reaction is substitution reaction where a hydrogen replaced chlorine.

Image ii



ii) Ethane formed by Ethyne is by the "Hydrogenation" of Ethyne. Propane formed by 1-chloropropane is by the "Reduction" of 1-chloropropane (an alkyl halide).

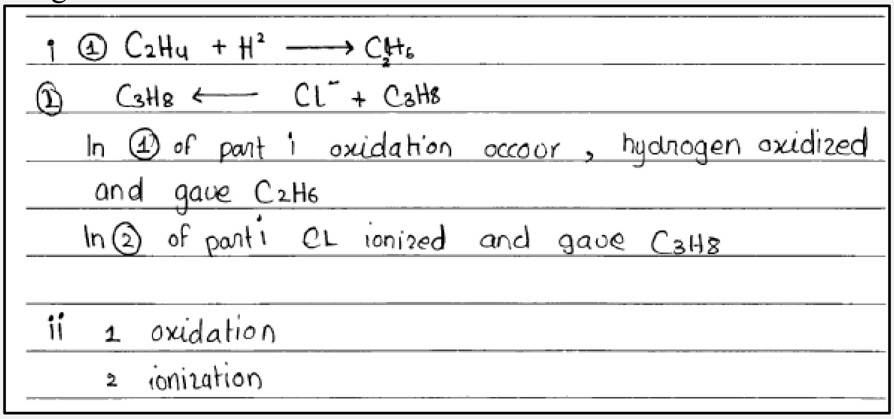
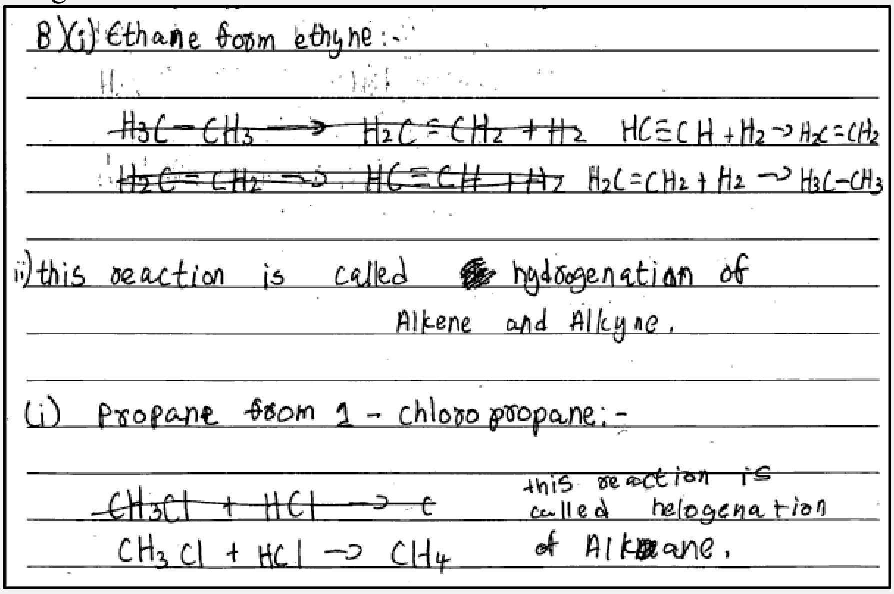
</td></tr>
<tr><td>Description of Weaker Responses</td><td>

In part (i), *weaker responses* revealed a lack of conceptual clarity in identifying correct reactants and products. A common error was the reversal of roles, where candidates incorrectly selected the product as the reactant, leading to flawed chemical equations and overall misrepresentation of the reaction pathway.

In the second reaction of part (i), many candidates did not draw the skeletal or condensed structural formulae of 1-chloropropane, opting instead for molecular formulae. This approach resulted in the loss of marks, as molecular formulas do not indicate the position of the chlorine atom, which is critical for this transformation. Furthermore, candidates who incorrectly placed the chlorine atom at the second carbon (2-chloropropane) rather than the first (1-chloropropane) were penalised for incorrect structure drawing.

In part (ii), the majority of *weaker responses* failed to accurately name the reactions. Some either swapped the names (e.g., calling hydrogenation as 'reduction' and vice versa) or displayed confusion among similar-sounding terms such as dehalogenation, dehydrohalogenation, and dehydrogenation. Additionally, a few candidates provided completely irrelevant or incorrect reaction names, such as oxidation, ionisation, or others

</td></tr>
</table>

	that did not relate to the chemical transformations described. These misconceptions highlight a lack of familiarity with fundamental organic reaction types and terminology. *Weaker responses* also failed to mention necessary reaction conditions and by-products where required.
Images of Weaker Response	Image i  1 ① $C_2H_4 + H^2 \longrightarrow C_2H_6$ ① $C_3H_8 \longleftarrow Cl^- + C_3H_8$ In ① of part i oxidation occour, hydrogen oxidized and gave C_2H_6 In ② of part i CL ionized and gave C_3H_8 ii 1 oxidation 2 ionization Image ii  B)(i) Ethane from ethyne:- ~~$H_3C-CH_3 \rightarrow H_2C=CH_2 + H_2$~~ $HC\equiv CH + H_2 \rightarrow H_2C=CH_2$ ~~$H_2C=CH_2 \rightarrow HC\equiv CH + H_2$~~ $H_2C=CH_2 + H_2 \rightarrow H_3C-CH_3$ ii) this reaction is called hydrogenation of Alkene and Alkyne. (i) Propane from 1 - chloro propane:- ~~$CH_3Cl + HCl \rightarrow C$~~ $CH_3Cl + HCl \rightarrow CH_4$ this reaction is called helogenation of Alkane.

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	• 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

• Utilise the resource guide for additional materials		

Any Additional Suggestion: Teachers should identify and encourage high-achieving or 'star' students to explore and propose alternative synthetic routes from the given reactant to the desired product. This practice not only raises higher-order thinking and creativity but also nurtures the skills of retrosynthetic analysis, a hallmark of proficient organic chemists. By promoting such analytical thinking, students can strengthen their conceptual understanding of functional group transformations and reaction mechanisms for the HSSC level and beyond.

Question No. 6a	
Question Text	i. Name the man-made chemical substance that causes ozone depletion. ii. Using balanced chemical equations, illustrate the destruction of the ozone layer. iii. Write any TWO harmful effects of ozone depletion
SLO No.	14.5.2
SLO Text	Describe ozone depletion and its effects;
Max Marks	6
Cognitive Level	U
Checking Hints	i. 1 mark for naming chlorofluorocarbon ii. 1 mark for writing each equation (3 required) iii. 1 mark for writing each effect of ozone depletion (any 2 required)
Overall Performance	The majority of the candidates opted for this ERQ option. Many candidates demonstrated a strong understanding of the causes and effects of ozone depletion. However, a significant number struggled to accurately present the causes and relevant chemical equations associated with ozone depletion in the stratosphere, although most were able to successfully identify and explain its harmful effects.
Description of Better Responses	*Better responses* exhibited a clear and comprehensive understanding of the concept of ozone depletion. In part (i), candidates accurately identified the man-made chemical responsible for ozone depletion, such as chlorofluorocarbons (CFCs) or their chemical formula $CFCl_3$ CF_2Cl_2, etc. In part (ii), candidates effectively demonstrated the mechanism of ozone destruction by writing the balanced chemical equations involving chlorine free radicals. These responses included: • The use of UV light/ sunlight in the initiation step to generate radicals. • A clear representation of the radical symbol (•) on chlorine atoms ($Cl^•$). • Inclusion of the three stages of a free-radical chain reaction—initiation, propagation, and termination—with accurate chemical equations showing depletion of ozone. • In some cases, candidates clubbed the equations appropriately using the correct stoichiometry and radical notation, showcasing a solid grasp of the chemical mechanism. In part (iii), candidates concluded with two scientifically valid harmful effects of ozone layer depletion. Most commonly cited effects included: • Skin cancer and cataracts due to increased UV exposure. • Disruption of the food chain and immune system disorders.

Images of Better Response

Image i

ans) Part a: i) The made chemical substances which causes the ozone depletion are CFC's also known as chloroflourocarbons. ($CFCl_3$) in Aerosole spray.

ii) The CFCs one way or another escape or diffuse into the stratospher where the Ultraviolet rays break the C-Cl bond. and chlorine radical is produced.

$CFCl_3 \xrightarrow{UV} CFCl_2 + Cl^{\bullet}$

This chlorine radical destroy's the ozone layer.

$O_3 + Cl^{\bullet} \rightarrow OCl + O_2$

$OCl \rightarrow O^{\bullet} + Cl^{\bullet}$

$O^{\bullet} + O^{\bullet} \rightarrow O_2$

iii) Ozone depletion allows the Ultra violet to reach the earth causing skin cancer.

2) It can result in the formation of cataract in eye.

3) If ozone depletion takes place it can increas in spread infectious diseases like malaria.

4) It damages crops

5) It can disrupt food chain.

Image ii

a) i) Aerosol sprays and coolants of refrigerators that release chlorofluoro-carbons.

ii) $CFCl_3 \xrightarrow{UV} CFCl_2 + Cl^{\bullet}$

$O_3 + Cl^{\bullet} \rightarrow O_2 + OCl^{\bullet}$

$OCl^{\bullet} \rightarrow O^{\bullet} + Cl^{\bullet}$

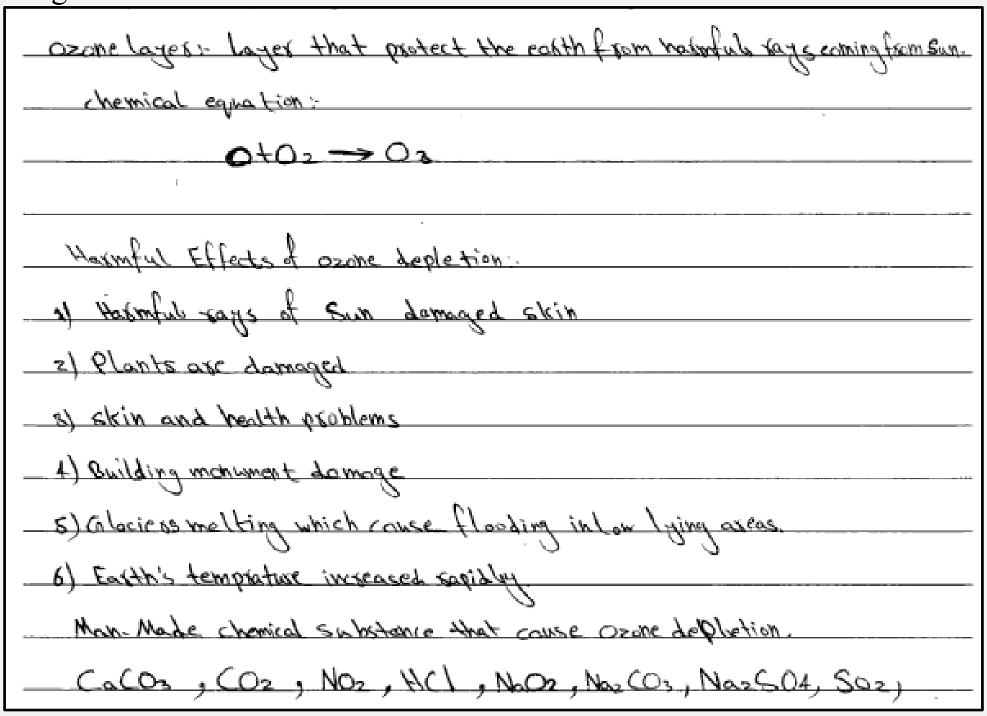
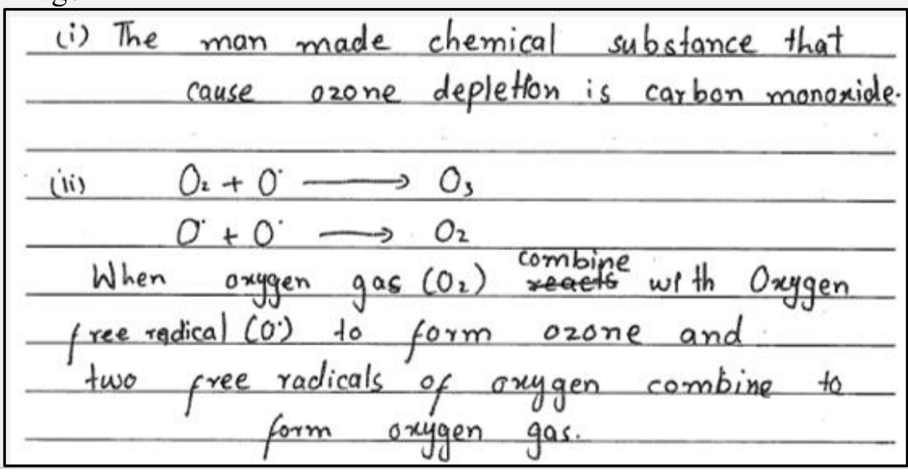
$O^{\bullet} + O^{\bullet} \rightarrow O_2$

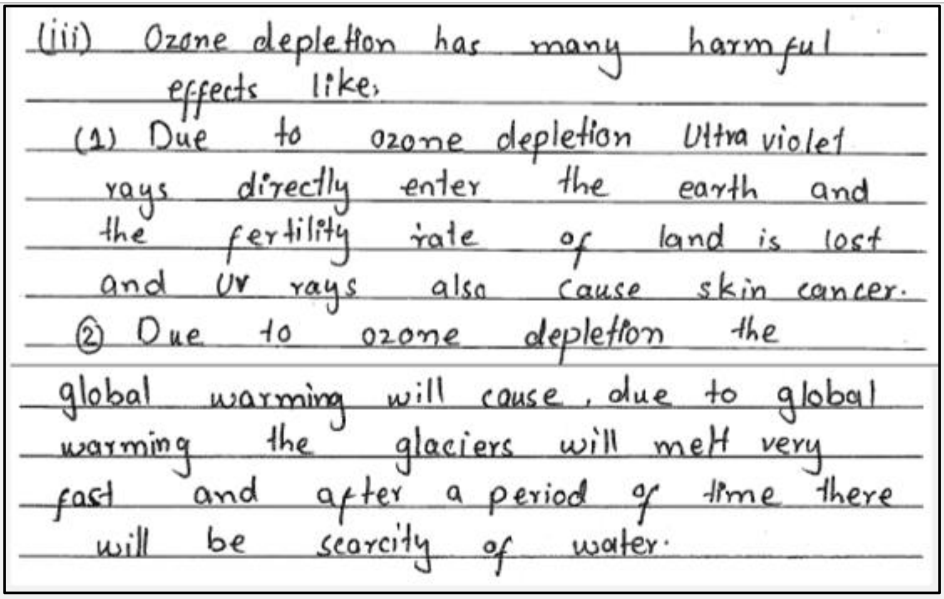
iii) Ozone is the part of stratosphere which doesnt let UV rays pass through. Ozone depletion causes these problems:

1) UV rays reaching earth, humans and animals causes skin diseases such as skin cancer, rashes and contageous diseases such as malaria.

2) Ozone depletion is the cause of rise in temperature of earth's atmosphere. This rise in temperature causes ice glaciers and ice caps to melt. Due to this melting, rivers start overflowing which cause floods and low lying areas are at the risk of submerging in water

∴ One chlorine free radical can destroy lacs of ozone molecules. The place from where the ozone is depleted is called ozone hole.

Description of Weaker Responses	*Weaker responses* in part (i) demonstrated confusion in identifying the correct man-made chemical responsible for ozone depletion. Instead of mentioning chlorofluorocarbons, candidates incorrectly cited substances such as carbon monoxide, carbon dioxide, HCl, NO_x, or simply chlorine and carbon monoxide. In part (ii), many candidates failed to provide correct and balanced chemical equations for the destruction of ozone by a free radical of chlorine. Some responses confused this with the natural ozone cycle, while others included only a single equation without indicating radical formation or the role of UV/ light energy. Common mistakes included omitting radical symbols or failing to acknowledge the initiation step of the chain reaction. In part (iii), candidates generally provided vague or inaccurate harmful effects of ozone layer depletion. Frequently cited examples included • skin burn, • eye infections, and • increased IR exposure. Several candidates also attributed climate-related issues, such as a rise in average temperature, melting of glaciers, and floods, to ozone depletion, reflecting confusion between ozone layer depletion and global warming. While both share human activities as a root cause, ozone depletion itself does not directly cause climate change, and this distinction was not clearly understood in weaker responses.
Images of Weaker Response	Image i  ozone layer:- layer that protect the earth from harmful rays coming from sun. chemical equation:- $O + O_2 \rightarrow O_3$ Harmful Effects of ozone depletion: 1) Harmful rays of sun damaged skin 2) Plants are damaged 3) skin and health problems 4) Building monument damage 5) Glaciers melting which cause flooding in low lying areas. 6) Earth's temprature increased rapidly Man-Made chemical substance that cause ozone depletion. $CaCO_3$, CO_2, NO_2, HCl, NaO_2, Na_2CO_3, Na_2SO_4, SO_2, Image ii  (i) The man made chemical substance that cause ozone depletion is carbon monoxide. (ii) $O_2 + O^{\cdot} \longrightarrow O_3$ $O^{\cdot} + O^{\cdot} \longrightarrow O_2$ When oxygen gas (O_2) ~~reacts~~ combine with Oxygen free radical ($O^{\cdot}$) to form ozone and two free radicals of oxygen combine to form oxygen gas.


(iii) Ozone depletion has many harmful effects like,
(1) Due to ozone depletion Ultra violet rays directly enter the earth and the fertility rate of land is lost and UV rays also cause skin cancer.
(2) Due to ozone depletion the global warming will cause, due to global warming the glaciers will melt very fast and after a period of time there will be scarcity of water.

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 teach this concept, animated videos are the most effective tool.		

Question No. 6b	
Question Text	Briefly describe any SIX steps involved in the metallurgical process.
SLO No.	16.1.2
SLO Text	Describe metallurgical operations.
Max Marks	6
Cognitive Level	U
Checking Hints	1 mark for describing each step (any 6 required) 2 marks will be awarded if the candidate mentions only the names of any 6 metallurgical processes.

Overall Performance	Overall, candidates performed satisfactorily on this question; however, it was attempted by comparatively fewer candidates than part (a). Those who opted for this question generally demonstrated a reasonable understanding of the topic, although some candidates mentioned descriptions of a few operations and left others as identified terms.
Description of Better Responses	*Better responses* demonstrated a clear understanding of the question by accurately identifying the steps involved in the extraction of metals from their ores, encompassing both physical and chemical processes. Many candidates effectively divided the process into three main stages: concentration of ores, roasting or calcination, and refining. These stages were further broken down into detailed sub-steps. Additionally, better responses presented the steps in chronological order, clearly explaining the purpose and function of each process, and often supported their answers with relevant examples of metals corresponding to each stage. In some responses, candidates also mentioned correct chemical equations for the steps where chemical reactions are involved.
Images of Better Responses	Image i Metallurgy is the process of removing or extracting a metal from its ore, done comercially at low cost. Following are the six steps of metallurgical process. ① Grinding / Crushing:- The ore from which the metal is to be extracted is Crushed to increase its surface area so further processes are efficiently done. ② Concentration is a separation technique used to separate gangue particles i.e impurities from the ore. There are three types of Concentration based on the type of ore. ⓐ Gravity separation is based on the difference in densities of ore and gangue particles. ⓑ Froth floatation is based on the wetting characteristic of ore and gangue particles with oil and water respectively. ⓒ Magnetic separation is based on the magnetic ore and non-magnetic gangue particles separated by electromagnets or any other magnet. ③ After concentration, the concentrate enters extraction where it is roasted at a temperature less than its melting point in order to remove volatile impurities and moisture from it. ④ Roasted metallic ore moves for smelting in furnace where it is heated with a reducing agent. Here metal mostly reduces and makes molten metal. ⑤ Molten metal then enters Bessemer converter and here besemerization takes place in which hot air is blown through the molten metal to further remove its impurities with the air. ⑥ Refining is mostly the last step of purification of metal through Chemical refining or electrolysis in which Anode / Cathode reactions take place and metal is given out.

<table>
<tr><td></td><td>Image ii

- Metallurgical process involves.
I. Concentration of ore.
II. Roasting of ore.
III. Refining of ore.

I. Concentration of ore.
1. Magnetic separation (Iron):- After washing and crushing the ore (Fe_3O_4) the mixture is sent to the magnetic belt. Then the magnetic materials/substance are separated from the non-magnetic materials.
2. Froth-flotation process (Copper):- In this process, the ore ($CuFeS_2$) is dipped into pine oil and water. Heavier particles settled down while lighter gangue particles float on water as froths. which can be skimmed.
3. Gravity separation process (Aluminium):- In this process, the ore ($Al_2O_3.nH_2O$) is separated due to difference in their densities.

II. Roasting of ore:-
4. Roasting of ore (Iron):- The concentrated ore is now heated in the presence of air to separate impurities, CO_2, etc.
III. Refining of ore:-
5. Reduction of ore (Iron):- The ore is reduced in a blast furnace which is a cylindrical tower of 25m to 35m high in which different reaction take place at different temperature like
$C + O_2 \rightarrow CO_2$; $CO_2 + C \rightarrow 2CO$ (reducing agent) in the last iron is obtained
6. Electrolytic refining (Copper):- Copper is electrolyse here. Anode is made up of blister copper while cathode is made up of pure copper. Different reactions take place here like at anode.
$Cu \rightarrow Cu^{+2} + 2e^-$; at cathode $Cu^{+2} + 2e \rightarrow Cu$ in the last pure copper is obtain</td></tr>
<tr><td>Description of Weaker Responses</td><td>Some weaker responses merely identified the names of the processes involved without providing any description, which resulted in a loss of marks. A few candidates presented flowcharts that listed only the process names, lacking any explanation of their purpose or function, which killed the purpose of an ERQ. Overall, such responses were either incomplete or too vague to meet the content requirements of the question.</td></tr>
</table>

Images of Weaker Response

Image i

1) Crushing and Grinding: In order to extract the metal from an ore, the first step we do is the crushing and grinding of the ore in which we, as the name suggest, crush and grind the ore.

2) Froth floration Process: Another procedure that we do in order to extract the metal from the ore is the froth floration process where the ore is broken down into small parts to be removed. This is the third step of the metallurgical process.

3) Gravity Seperation method: This is a procedure that helps in the extraction of the metal by seperating the metal and the ore with the help of gravity. This is the second step of the metallurgical process.

4) Electromagnetic Separation: ~~This is~~ In this step the metal mixed with the ore is put on a magnetic conveyor belt. The ore does not stick to the magnet therefore it is dropped from the end of the conveyor belt into the first cart while the metal is attracted to the magnet for a little while before falling into the second cart.

Image ii

1 - The metal ore is Crushed or grinded in order for the ore to be used easily

2 - Next the impurities are removed by the following methods
> Gravitational / Hydrolic seperaration
or Electrolytic seperation
or Chemical seperation / leaching
or froth flotation

3 - Next it is oxidised by the following methods
Roasting or Calcination

4 - Then the oxygen is removed
> (we added oxygen, because it was easy to remove)

5 - It is purified again by using Distillation or Electrolisis

6 - The impurities are removed and we get or metal.

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: Teachers should provide a thorough understanding of each process used in metallurgy and their respective purposes, and that also in chronological order.		

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. 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, 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.)

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- Ms Nadia Kousar, Sultan Muhammad Shah Aga Khan School, Karachi
- Ms Syeda Khadija Hasan, Habib Public School, Karachi
- Ms Maheen Amjad, PECHS Girls' School, Karachi
- Ms Saba Gul, BVS Parsi High School, Karachi

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These contributors include:

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