AGA KHAN UNIVERSITY EXAMINATION BOARD

Notes from E-Marking Centre HSSC-I Biology Annual Examinations 2023

Introduction

This document has been prepared for the teachers and candidates of Higher Secondary School Certificate (HSSC) Part I (Class XI) Biology. It contains comments on candidates' responses to the 2023 HSSC-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 which support the mentioned comments. Please note that the descriptive comments represent an overall perception of the better and weaker responses as gathered from the e-marking session. However, the candidates' responses shared in this document represent some specific example(s) of the mentioned comments.

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

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

General Observations

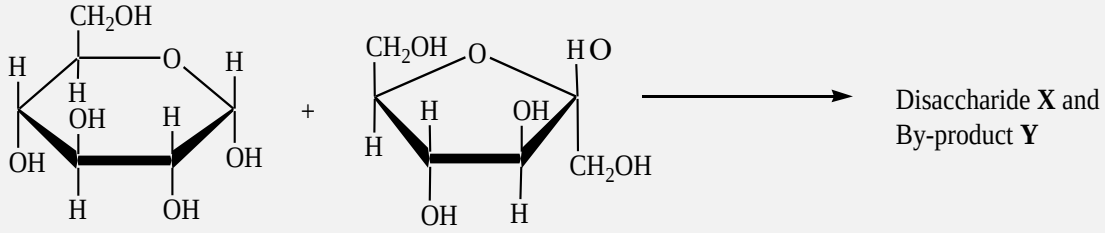
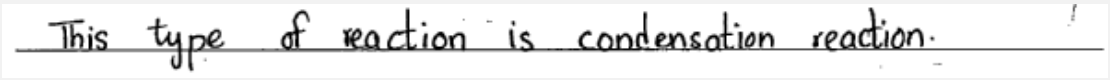
Candidates who did not score well mostly failed to understand the demand of the question, often misinterpreting the command word and the stimulus. Moreover, the interpretation of graphs and scientific reasoning displayed weaknesses. Mentioned below are a few concepts that teachers need to focus on so that the candidates may perform better.

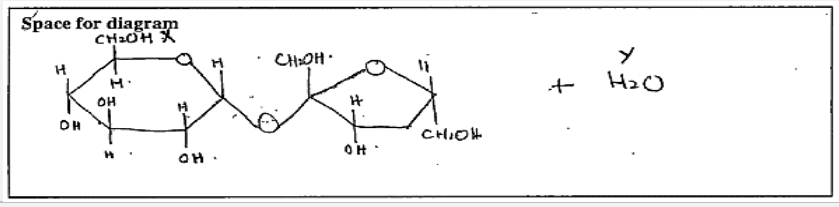
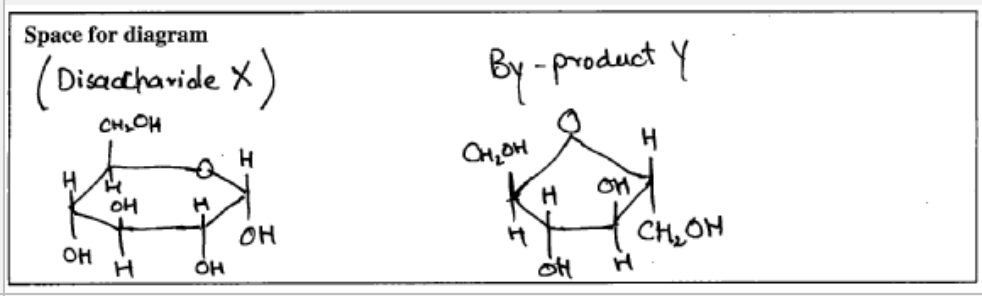
- Appropriate organisation of data using techniques such as tables and graphs
- Analysis of data to make predictions, decisions or draw conclusions
- Orientation of phospholipid molecules of cell membrane in water
- Functions of bicarbonate ions in the process of digestion
- Enhancement in the ability to provide scientific reasons for different biological phenomena
- Distinguish between hydrolysis and condensation reactions in various situations

However, candidates outperformed in some concepts, such as, identification of subcellular structure in electron micrograph, process of photolysis, adaptive features of reptiles to the terrestrial environment, features of amphibians which limit their chances of survival in the terrestrial environment and functions of plasma membrane.

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

DETAILED COMMENTS
Constructed Response Questions (CRQs)

Question No. 1	
Question Text	Consider the given reaction.  a. Identify the type of reaction. b. Draw the structure of disaccharide **X** and by-product **Y** in the given space. c. Name the type of bond formed in the disaccharide.
SLO No.	2.4.4
SLO Text	Illustrate the formation and breakage of disaccharides, i.e., maltose, sucrose and lactose.
Max Marks	4
Cognitive Level	A*
Checking Hints	a. 1 mark for stating the type of reaction. b. 1 mark for drawing the structure of disaccharide. 1 mark for drawing/ showing the removal of water. c. 1 mark for naming the type of bond.
Overall Performance	Most of the candidates demonstrated a solid understanding of the stimulus and correctly identified the type of reaction involved in the formation of a disaccharide. Moreover, their responses included a well-illustrated depiction of the disaccharide formation, showcasing the removal of water, and accurately naming the type of bond, specifically the alpha 1-2 glycosidic bond. This level of precision in interpretation showcases a deep understanding of the underlying biochemistry.
Description of Better Responses	1(a) Better responses adeptly analysed the provided diagram to deduce the precise nature of the reaction involved in forming a disaccharide, identifying it as either a condensation reaction or dehydration synthesis. 1(b) Better responses skillfully utilised the provided diagram to illustrate the formation of a disaccharide. By demonstrating the glycosidic bond between the two monosaccharides and explicitly showing the removal of water as a byproduct, a clear representation of the condensation reaction or dehydration synthesis process is depicted. 1(c) Better responses accurately identified the specific bond involved as an alpha 1-2 glycosidic bond. This level of comprehension and precision in their responses highlight the candidates' ability to apply their knowledge to practical scenarios, making the learning process more rewarding and successful.
Image of Better Response 1a	

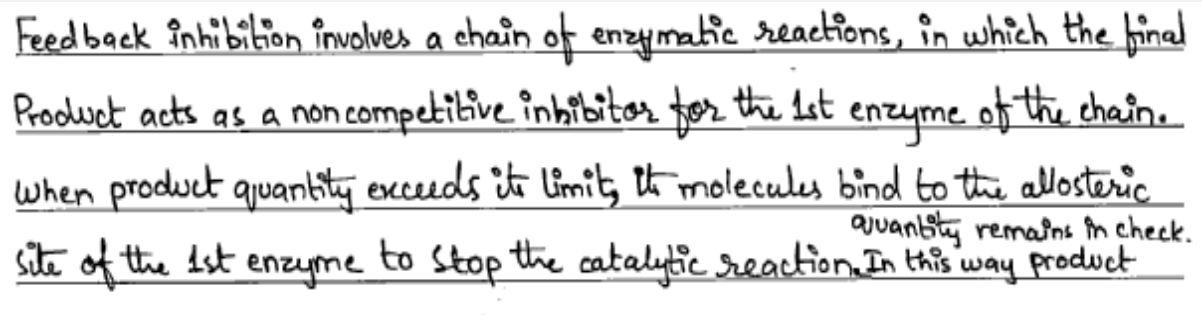
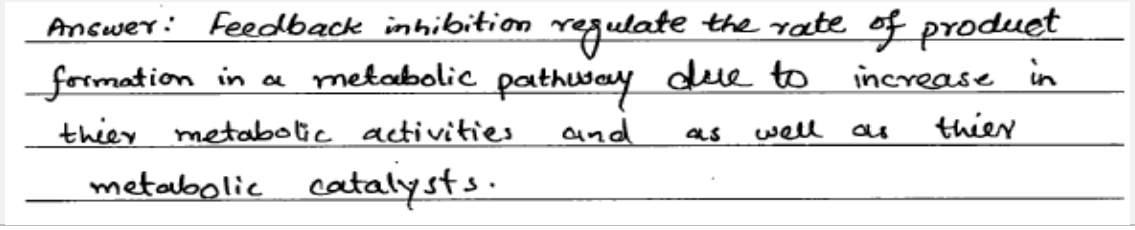
1b	
1c	Alpha 1-2 Glycosidic Linkage
Description of Weaker Responses	Weaker responses indicated a limited ability to effectively use the visual stimulus provided and often revealed a weak understanding of carbohydrate structures. These responses typically lack the necessary knowledge to illustrate the formation of a disaccharide, showcasing difficulties in identifying the glycosidic bond and the removal of water during the condensation reaction. These shortcomings may stem from a lack of comprehension or insufficient exposure to relevant teaching strategies.
Image of Weaker Response 1a	Disaccharide reaction
1b	
1c	Polypeptide bonding

Suggestions for Improvement (Highlighted part)

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)	• Storyboard • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual Resources • Think, Pair and Share • Knowledge Platform Videos	• Past paper questions • Discussion on E-Marking Notes • AKU-EB Digital Learning Solution powered by Knowledge Platform https://akueb.knowledgeplatform.com/login

• Go through the past paper questions on that particular concept • Refer to the resource guide for extra resources	• Questioning Technique (Socratic Approach) • Practical Demonstration ** For description of each pedagogy, refer to Annexure A	
Any Additional Suggestion: Teachers are advised to utilise diagrams, models, and charts to visually represent the structures of carbohydrates. Visuals help students grasp complex concepts better, especially when dealing with different types of monosaccharides and their linkages. Offering customised support and feedback can also be beneficial in addressing specific misconceptions and guiding students towards improvement.		

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

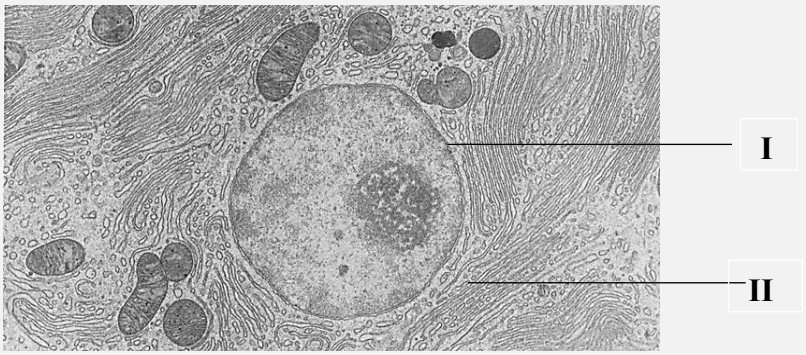
Question No. 2	
Question Text	How does feedback inhibition regulate the rate of product formation in a metabolic pathway?
SLO No.	3.5.3
SLO Text	Explain feedback inhibition.
Max Marks	3
Cognitive Level	U*
Checking Hints	1 mark for writing the final product in a series of reactions inhibiting an enzyme from an earlier step in the sequence. 1 mark for writing that product binds to an allosteric site and temporarily inactivates the enzyme (via non-competitive inhibition).
Overall Performance	Many candidates displayed a clear comprehension of feedback inhibition, effectively explaining its mechanism. However, a subset of candidates missed the marks by merely paraphrasing the question without delving into the accurate process of feedback inhibition.
Description of Better Responses	Better responses showcased a precise and comprehensive understanding of feedback inhibition. These responses appropriately explained that feedback inhibition involves the end-product of a metabolic pathway inhibiting an earlier step in the same pathway. This inhibition occurs through the binding of the end-product to the allosteric site of the first enzyme in the pathway. By clearly outlining this mechanism, these responses demonstrate a thorough grasp of the concept and the underlying biochemical processes involved. Such accurate explanations indicate a high level of comprehension and critical thinking on the part of the candidates.
Image of Better Response	
Description of Weaker Responses	In weaker responses, candidates rephrased the question rather than providing the correct answer. Some responses also indicated a lack of knowledge about the effect of end-product inhibition in feedback regulation. End-product inhibition is a critical concept in metabolic pathways, where the final product of a pathway inhibits its own synthesis by negatively regulating an enzyme earlier in the pathway.
Image of Weaker Response	

Suggestions for Improvement (Highlighted part)

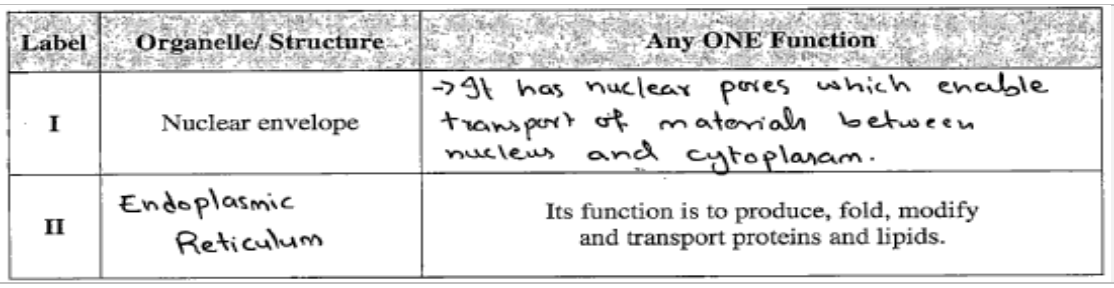
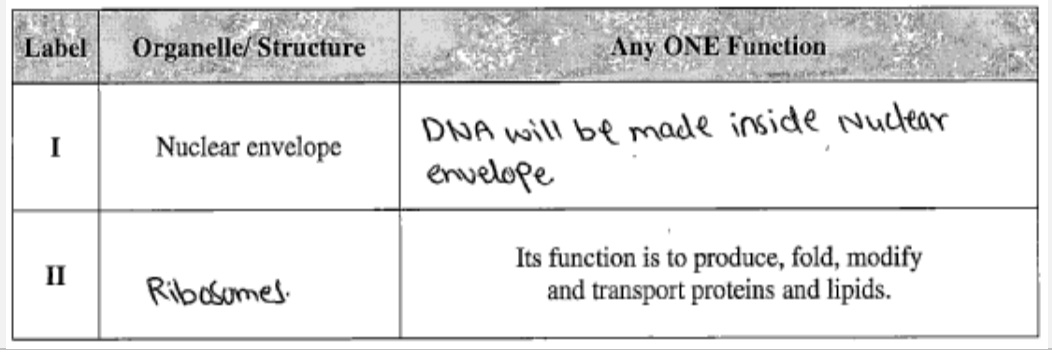
How to Approach SLO	Pedagogy Used for that SLO	Assessment Strategies
• Understand the expectations of the command words • Look at the cognitive level • Identify the content that is required to answer that question (both in terms of understanding of concepts and any skills that may be required like analysing or evaluating) • Go through the past paper questions on that particular concept • Refer to the resource guide for extra resources	• Storyboard • 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 are advised to offer supplementary materials such as videos, animations, or interactive simulations to cater to various learning styles and reinforce the concept of end-product inhibition. Additionally, they may incorporate practice exercises that involve analysing feedback inhibition in different metabolic pathways. This will challenge students to apply their knowledge and reinforce the concept.

<table>
<tr><th colspan="2">Question No. 3</th></tr>
<tr><td>Question Text</td><td>The given electron micrograph shows a section of an animal cell.
 

With reference to the given micrograph, complete the given table.
<table>
<tr><th>Label</th><th>Organelle/ Structure</th><th>ONE Function</th></tr>
<tr><td>I</td><td>Nuclear envelope</td><td></td></tr>
<tr><td>II</td><td></td><td>Its function is to produce, fold, modify and transport proteins and lipids.</td></tr>
</table></td></tr>
<tr><td>SLO No.</td><td>4.4.1</td></tr>
<tr><td>SLO Text</td><td>Explain structure, chemical composition and functions of the cellular organelles of animal and plant cell as revealed through the electron microscope:
a. cell wall b. cell membrane with reference to Fluid Mosaic Model c. cytoplasm d. endoplasmic reticulum e. ribosomes f. mitochondria g. Golgi apparatus h. lysosomes i. vacuoles j. cytoskeleton k. centrioles l. plastids m. nucleus.</td></tr>
<tr><td>Max Marks</td><td>2</td></tr>
<tr><td>Cognitive Level</td><td>U</td></tr>
<tr><td>Checking Hints</td><td>1 mark for completing each box as follows: (TWO required)
Function of Nuclear Envelope: It serves to separate the chromosomes from the rest of the cell/ contains receptors / facilitates the movement of mRNA and ribosomal RNA and other molecules from nucleus to cytoplasm and vice versa through nuclear pores.
Organelle/ Structure: Endoplasmic reticulum</td></tr>
<tr><td>Overall Performance</td><td>A considerable number of candidates performed well in this question. Their ability to effectively use the provided visual stimulus to identify the cellular structure and phrase accurate answers reflects a commendable understanding of intercellular organelles.</td></tr>
<tr><td>Description of Better Responses</td><td>Better responses revealed a higher level of understanding in cellular organelles which indicates that the candidates have successfully grasped the foundational concepts and can apply their knowledge to problem-solving scenarios effectively. Further, accurate identification of the cellular structures, i.e., endoplasmic reticulum in electron micrographs requires a higher level of understanding due to the complex and detailed nature of these images and describing the function of nuclear envelope in a cell demonstrates candidates' ability to analyse subcellular components accurately and apply theoretical knowledge to real-world visual representations.</td></tr>
</table>

Image of Better Response	 **Label** / **Organelle/ Structure** / **Any ONE Function** I — Nuclear envelope — → It has nuclear pores which enable transport of materials between nucleus and cytoplasam. II — Endoplasmic Reticulum — Its function is to produce, fold, modify and transport proteins and lipids.
Description of Weaker Responses	In weaker responses, candidates struggled to identify cellular organelles in an electron micrograph demonstrated a deficiency in comprehending the utilisation of electron micrographs for such discernment. Proficiency in recognising these organelles within electron micrographs demands a strong command of cell biology and a thorough understanding of the distinctive attributes of these organelles.
Image of Weaker Response	 **Label** / **Organelle/ Structure** / **Any ONE Function** I — Nuclear envelope — DNA will be made inside Nuclear envelope II — Ribosomes. — Its function is to produce, fold, modify and transport proteins and lipids.

Suggestions for Improvement (Highlighted part)

How to Approach SLO	Pedagogy Used for that SLO	Assessment Strategies
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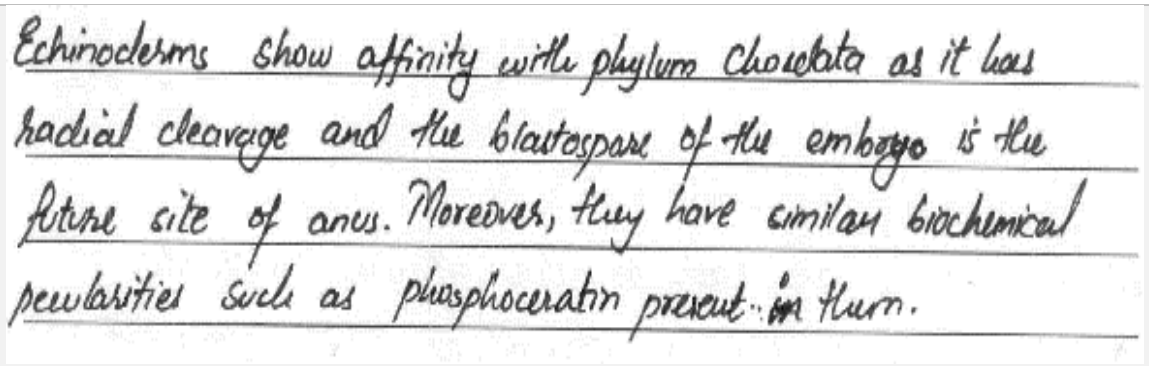
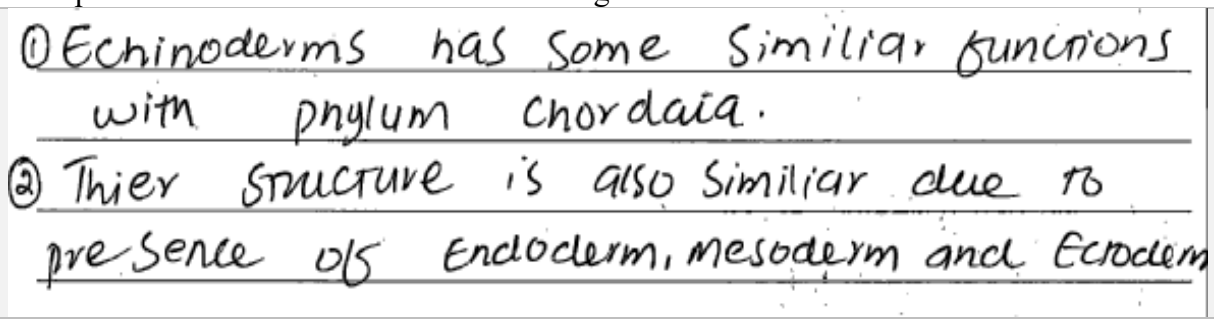
Any Additional Suggestion:
Teachers are highly recommended to offer practice exercises and quizzes that focus on identifying cellular organelles in electron micrographs. Encourage students to draw connections between the structures they observe and the organelles they have learned about.

Question No. 4	
Question Text	Write any TWO reasons for placing echinoderms closest to phylum chordata in the classification of kingdom animalia.
SLO No.	10.10.1
SLO Text	Explain general characteristics of spiny skinned animals (echinoderms) and their affinities;
Max Marks	2
Cognitive Level	U
Checking Hints	1 mark for each reason (any TWO required)
Overall Performance	Many candidates showed better performance in this question. Candidates wisely drafted the answers by providing relevant reasons for placing echinoderms closest to phylum chordata. This indicates a good understanding of the comparative anatomy and evolutionary relationships between different animal phyla. However, some candidates provided irrelevant answers not fulfilling the question's demand. This suggests that they might have misunderstood the context or lacked the necessary knowledge to provide an accurate response.
Description of Better Responses	In better responses, the candidates demonstrated a strong understanding of key similarities between echinoderms and chordates. They aptly highlight bilateral symmetry, radial cleavage, blastopore fate, shared biochemical traits, and the analogous development of coeloms. Additionally, the candidate notes the presence of mesodermal endoskeletons and ectodermal exoskeletons in both groups. These concise, accurate points showcase the candidate's grasp of comparative embryology, biochemical commonalities, and anatomical features. Providing specific examples and emphasising distinct features would further enhance their response. Overall, a comprehensive and well-structured analysis of shared traits in echinoderms and chordates.
Image of Better Response	 Echinoderms show affinity with phylum Chordata as it has radial cleavage and the blastospore of the embryo is the future site of anus. Moreover, they have similar biochemical peculiarities such as phosphocreatin present in them.

Description of Weaker Responses	Weaker responses revealed a poor understanding of comparative anatomy and evolutionary relationships between different animal phyla. These candidates lack the basic knowledge of the salient features of phylum Echinodermata and Chordata, which are crucial for understanding their placement in the classification of the kingdom Animalia.
Image of Weaker Response	

Suggestions for Improvement (Highlighted part)

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	• Storyboard • 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 are strongly recommended to emphasise the importance of comparative anatomy and how it allows scientists to identify similarities and differences between different taxa. Encourage candidates to analyse and compare specific features of Echinoderms and Chordates to understand their classification.

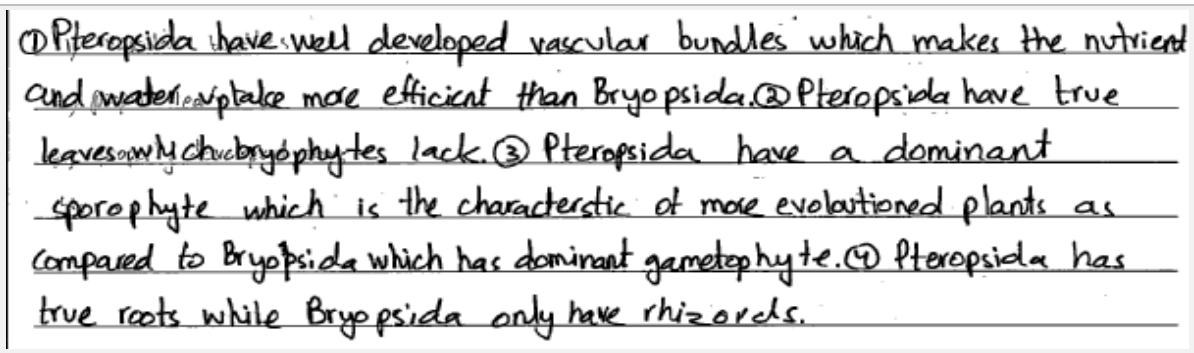
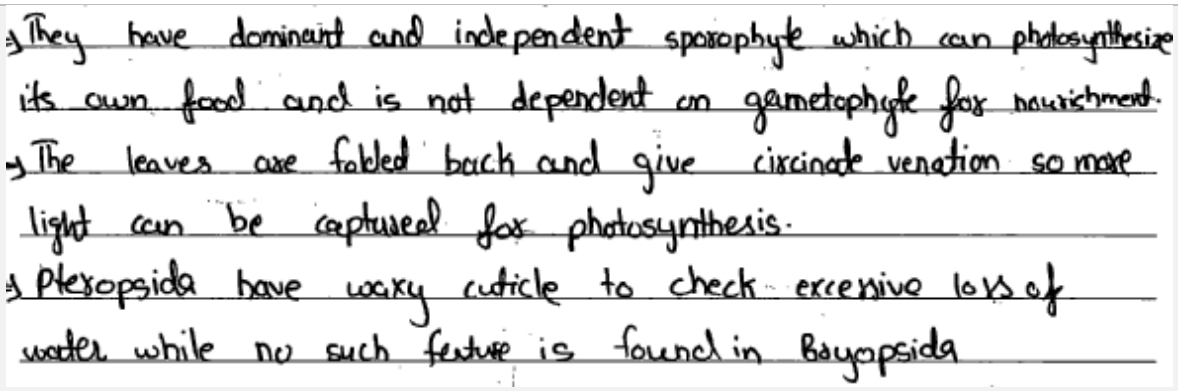
Question No. 5	
Question Text	Identify any THREE characteristics of Pteropsida that make them more advanced terrestrial plants than Bryopsida.
SLO No.	9.3.1; 9.2.5
SLO Text	Compare major groups of tracheophyta, i.e., a. psilopsida b. lycopsida c. sphenopsida d. pteropsida. Discuss the adaptive characteristics of bryophytes in the land habitat.
Max Marks	3
Cognitive Level	U
Checking Hints	1 mark for identifying each characteristic (any THREE required)
Overall Performance	A considerable number of candidates performed well in this question. Candidates demonstrated excellent analytical skills in identifying specific characteristic features of Pteropsids that contribute to their success as land plants compared to Bryopsids. Pteropsids and Bryopsids are both groups of land plants, but they exhibit distinct adaptations that influence their ecological success and survival strategies.
Description of Better Responses	In better responses, candidates adeptly outlined the key features of vascular plants, showcasing a sound grasp of plant anatomy and reproduction. They accurately noted the presence of true root, stem, and leaves, as well as the vascular systems for water and nutrient transport. The distinction between homosporous and heterosporous reproductive strategies was clearly conveyed, emphasising the evolution of seeds from protected sporangia. Additionally, the candidates highlighted the dominant sporophytic phase and reduced gametophyte in pteridophytes. Overall, they provided a concise and insightful evaluation of vascular plant characteristics.
Image of Better Response	
Description of Weaker Responses	Weaker responses primarily consisted of irrelevant characteristics of Pteropsids, indicating a lower level of understanding of the topic. The candidates' response tended to focus on general plant characteristics rather than highlighting the advanced traits specific to Pteropsida compared to Bryopsida. It is important to concentrate on features that set Pteropsida apart, such as true vascular tissues, dominance of the sporophytic phase, and the evolution of seeds from protected sporangia. Encouraging the candidates to delve deeper into these distinctions would lead to a more targeted and insightful comparison between the two groups of plants.

Image of Weaker Response	

Suggestions for Improvement (Highlighted part)

How to Approach SLO	Pedagogy Used for that SLO	Assessment Strategies
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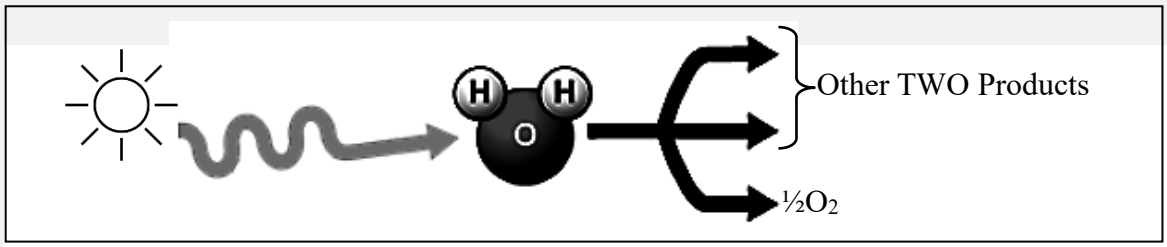
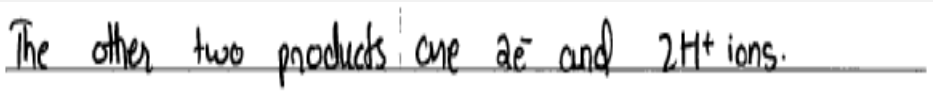
Any Additional Suggestion:
Teachers can facilitate the students to create comparative tables that outline the unique traits of each major group side by side. This approach allows students to easily identify similarities and differences between the groups.

Question No. 6	
Question Text	The given diagram outlines the process of photolysis that occurs during the light-dependent reactions of photosynthesis.  Name the TWO products other than oxygen.
SLO No.	11.2.6
SLO Text	Describe main events of light dependent reactions (energy conversion, formation of ATP and NADPH).
Max Marks	2
Cognitive Level	U
Checking Hints	1 mark for naming 2 Protons/ 2H+ ions 1 mark for naming 2 electrons/ $2e^-$
Overall Performance	A significant number of candidates accurately identified the two products of photolysis by intelligently using the provided visual stimulus. Their ability to effectively analyse the diagram demonstrates their skill in connecting the visual information to the specific process of photolysis in photosynthesis. However, some candidates overlooked the given diagram or did not focus on the question, resulting in generalised answers related to the overall light-dependent reactions of photosynthesis. This indicates a lack of attention to detail and may suggest a weaker understanding of the specific process of photolysis.
Description of Better Responses	Better responses revealed strong understanding of the concept of photolysis in light dependent reactions of photosynthesis, i.e., one molecule of water on splitting inside chloroplast produces two electrons and two protons other than a half molecule of oxygen. Further, these responses depict ability to carefully analyse diagrams and images to extract relevant information.
Image of Better Response	
Description of Weaker Responses	Weaker responses displayed poor comprehension of photolysis as a first chemical step of photosynthesis. Instead of providing a precise answer with the help of the given diagram, these responses offered generalised answers, indicating a lack of understanding of the specific process of photolysis. It is concerning to note that most responses incorrectly identified ATP and NADPH as the product of photolysis due to misinterpretation of the question. Photolysis is the process of breaking down water molecules (H_2O) into oxygen (O_2), protons (H^+) and electrons (e^-), not ATP and NADPH.
Image of Weaker Response	

Suggestions for Improvement (Highlighted part)

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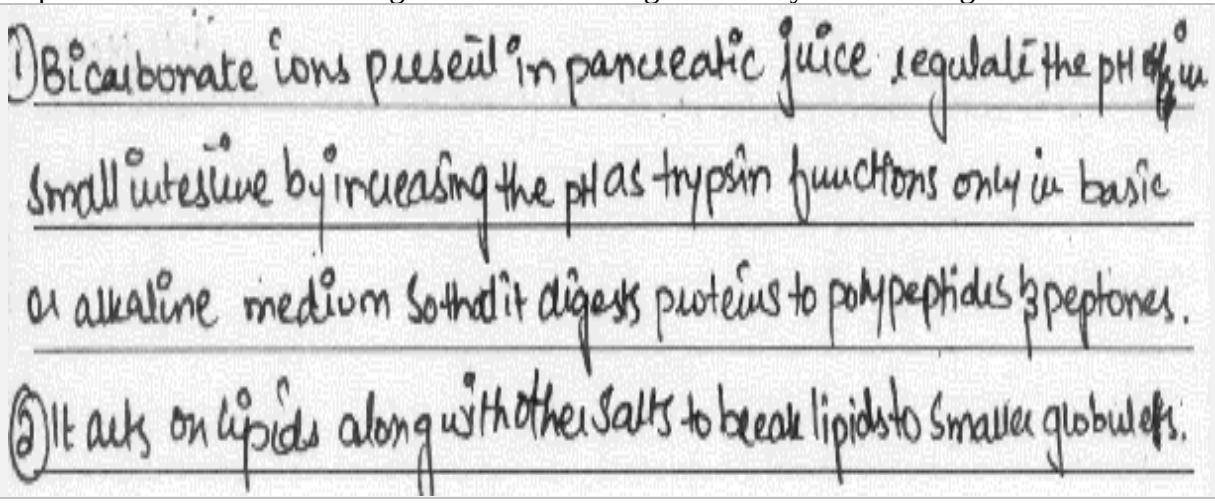
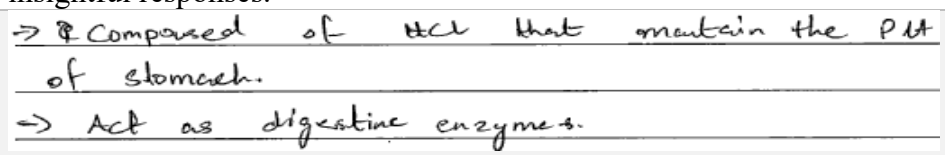
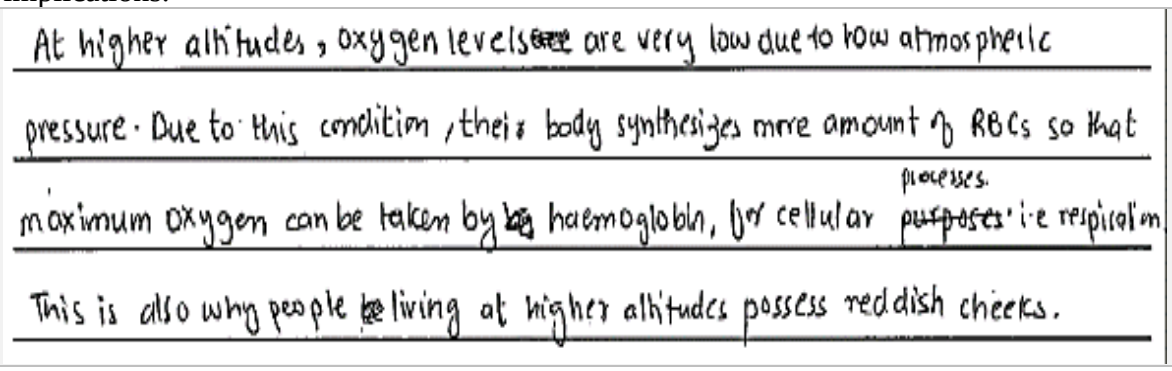
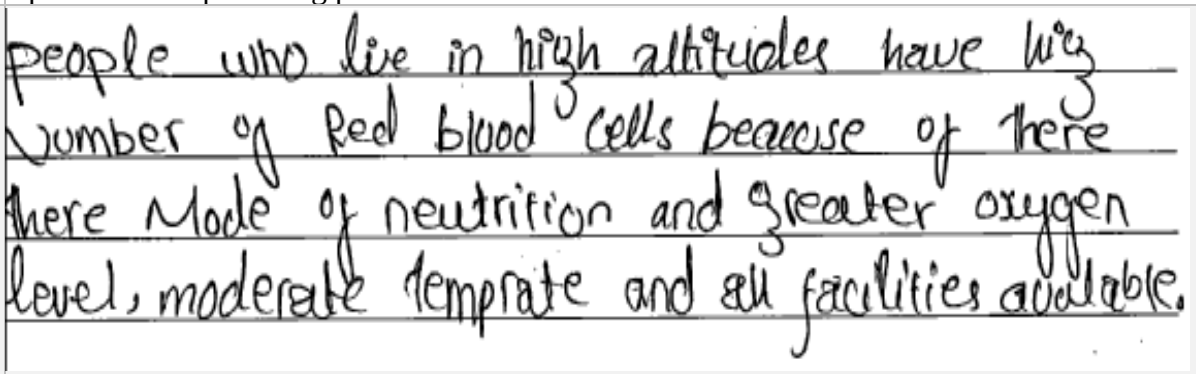
Any Additional Suggestion:
Teachers are advised to encourage candidates to critically analyse the question and the information provided before formulating their responses. This will help them avoid misconceptions and errors in their answers.

Question No. 7	
Question Text	Describe TWO functions of bicarbonate ions present in pancreatic juice, which helps in digestion.
SLO No.	12.4.2
SLO Text	Discuss the process of digestion of carbohydrates, proteins and lipids in human being.
Max Marks	2
Cognitive Level	U
Checking Hints	1 mark for each function of bicarbonate ions (any TWO required)
Overall Performance	Most of the candidates secured 50% marks in this question. It seems there might be some confusion or misunderstanding among the candidates regarding the functions of bile and bicarbonate ions. It is essential for candidates to understand the correct functions of these substances, as they play crucial roles in the digestive process. Encouraging them to review these concepts and seek clarification if needed should help in improving their understanding.
Description of Better Responses	Candidates provided better responses by elucidating the crucial roles of bicarbonate ions in the digestive process. They accurately pinpoint the buffering action against acidic chyme, ensuring enzyme activity in the small intestine. Moreover, they insightfully describe bicarbonate ions' chaotropic property that aids macromolecule solubilisation. This exhibits a deep understanding of the digestive system's intricacies and its components' interplay. Such comprehensive explanations demonstrate a high level of knowledge and analytical thinking.
Image of Better Response	 1) Bicarbonate ions present in pancreatic juice regulate the pH of in small intestine by increasing the pH as trypsin functions only in basic or alkaline medium So that it digests proteins to polypeptides & peptones. 2) It acts on lipids along with other salts to break lipids to smaller globules.
Description of Weaker Responses	In weaker responses, some candidates exhibited confusion by focusing on the functions of bile or hydrochloric acid instead of accurately addressing the role of bicarbonate ions in pancreatic juice. This indicates a lack of grasp on the digestive process. Encouraging candidates to deeply comprehend the distinct roles of each digestive component is essential to prevent such misconceptions. A strong understanding of these functions will lead to more accurate and insightful responses.
Image of Weaker Response	 => It Composed of HCl that maintain the PH of stomach. => Act as digestive enzymes.

Suggestions for Improvement (Highlighted part)

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	• Storyboard • 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

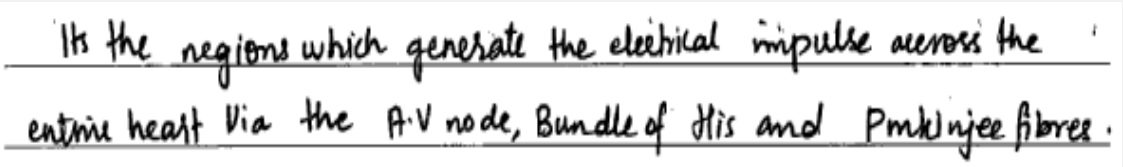
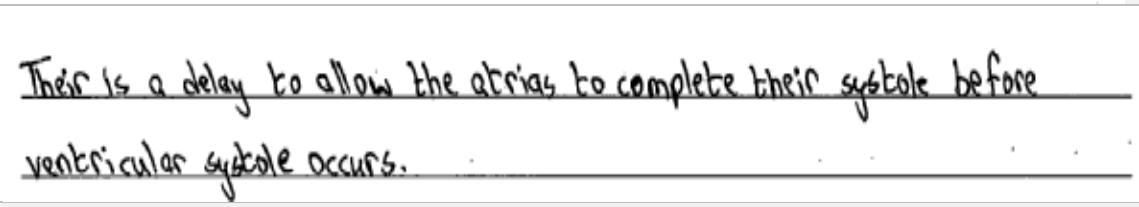
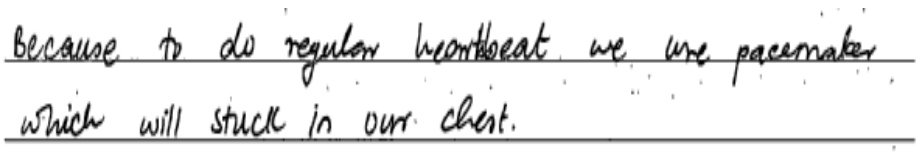
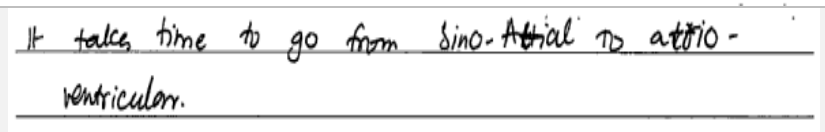
Any Additional Suggestion:
Teachers should emphasise the importance of a thorough understanding of the content and provide opportunities for candidates to clarify any doubts they may have. This approach will lead to better-informed responses and a deeper grasp of the topics being assessed.

Question No. 8	
Question Text	Describe why more red blood cells are produced in the body of people who live at higher altitudes.
SLO No.	13.3.4
SLO Text	Explain transportation of carbon dioxide and oxygen by the blood.
Max Marks	2
Cognitive Level	U
Checking Hints	1 mark for writing each point (TWO required)
Overall Performance	Majority of the candidates secured 50% marks in this question. These candidates correctly mentioned the lower partial pressure of oxygen at higher altitudes. However, they struggled to relate its effect on the function of red blood cells. Understanding this relationship is crucial to grasp the physiological response to changes in oxygen availability.
Description of Better Responses	In better responses, candidates showcased strong understanding by explaining how altitude affects haemoglobin saturation. They accurately noted the reduced oxygen pressure and content at higher altitudes, leading to lower saturation levels. Their insights into the necessity of increased haemoglobin for effective oxygen transport revealed grasp of physiological nuances. Overall, these responses reflected sound knowledge and aptitude for connecting concepts in explaining the impact of altitude on oxygen saturation and its physiological implications.
Image of Better Response	 At higher altitudes, oxygen levels are very low due to low atmospheric pressure. Due to this condition, their body synthesizes more amount of RBCs so that maximum oxygen can be taken by haemoglobin, for cellular processes. i.e respiration. This is also why people living at higher altitudes possess reddish cheeks.
Description of Weaker Responses	Several responses exhibited confusion by including unrelated factors like temperature or eating habits when discussing the effects of higher altitudes on red blood cell function. This detracted from the accuracy and cohesiveness of their responses. It is crucial to stress careful reading of questions and providing pertinent answers.
Image of Weaker Response	 people who live in high altitudes have less number of Red blood cells because of there there Mode of neutrition and greater oxygen level, moderate temprate and all facilities available.

Suggestions for Improvement (Highlighted part)

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	• Storyboard • 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 guide the candidates to focus on the core concepts related to the question and avoid introducing unrelated information. Providing practice questions and clear explanations can help candidates improve their understanding and response quality over time. Encouraging critical thinking and application of knowledge will also help them develop a deeper comprehension of scientific concepts and their interrelationships.

Question No. 9	
Question Text	Give a reason for each of the following statements. • Sino-atrial (SA) node is referred to as the pacemaker of the heart. • There is a delay of approximately 0.15 second in conductance of impulses from the sino-atrial node to atrio-ventricular node.
SLO No.	14.7.6
SLO Text	Relate the function of the artificial pacemaker with that of the sino-atrial node.
Max Marks	2
Cognitive Level	U
Checking Hints	1 mark for writing each reason (TWO required)
Overall Performance	A considerable number of candidates performed well in this question by providing the relevant reasons. However, some candidates lacked understanding related to the sinoatrial node as the pacemaker of the heart and the reason for the delay in conducting impulses from the sinoatrial node to the atrioventricular node.
Description of Better Responses	Candidates demonstrated a strong understanding of cardiac physiology. They precisely outlined the SA node's role as the pacemaker, orchestrating heart contractions. Furthermore, they provided an insightful rationale for the delay in impulse conduction to the AV node, highlighting its significance in optimising the coordination between atrial and ventricular contractions. These responses showcased a clear grasp of cardiac mechanics, displaying a comprehensive understanding of the subject matter and its physiological intricacies.
Image of Better Response 9a	
Image of Better Response 9b	
Description of Weaker Responses	Several responses deviated by discussing the placement of artificial pacemakers, which was irrelevant. Others provided unrelated, generalised answers, reflecting confusion and inaccuracies. In part (b), restating the question instead of explaining the 0.15-second delay suggested misunderstanding or insufficient knowledge. This might indicate candidates' unfamiliarity with the physiological process and the importance of the delay.
Image of Weaker Response 9a	
Image of Weaker Response 9b	

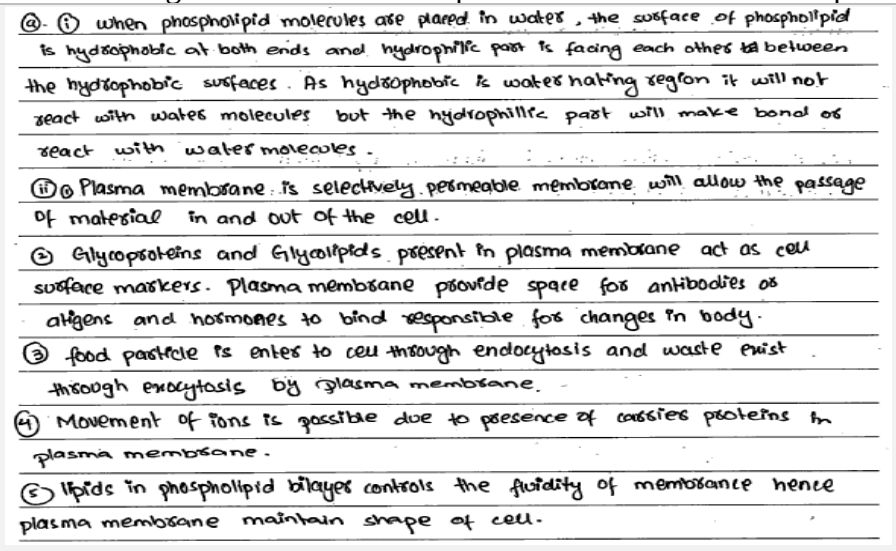
Suggestions for Improvement (Highlighted part)

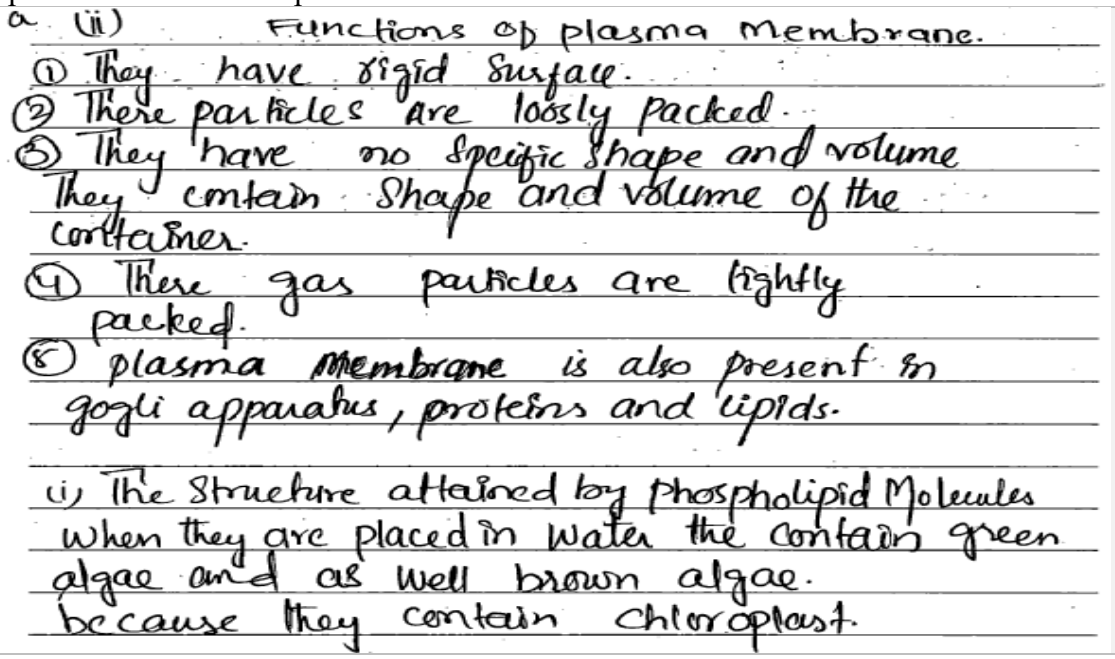
How to Approach SLO	Pedagogy Used for that SLO	Assessment Strategies
• Understand the expectations of the command words • Look at the cognitive level • Identify the content that is required to answer that question (both in terms of understanding of concepts and any skills that may be required like analysing or evaluating) • Go through the past paper questions on that particular concept • Refer to the resource guide for extra resources	• Storyboard • 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 are advised to offer practice questions or scenarios that require candidates to apply their knowledge of the heart's electrical system and its functions can help reinforce the concepts and reduce the tendency to rephrase questions without providing accurate answers.

Extended Response Questions (ERQs)

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

Question No. 10a	
Question Text	i. Describe the structure attained by phospholipid molecules when they are placed in water. ii. Describe any FIVE functions of plasma membrane.
SLO No.	4.4.1
SLO Text	Explain structure, chemical composition and functions of the cellular organelles of animal and plant cell as revealed through the electron microscope: b. cell membrane with reference to Fluid Mosaic Model
Max Marks	7
Cognitive Level	U
Checking Hints	i. 1 mark for mentioning that the lipid ends of molecules tend to aggregate forming micelles with a phosphate group projecting out into the water. 1 mark for phospholipid molecules form a bilayer with the polar (hydrophilic) ends facing water and non-polar (hydrophobic) ends facing each other. ii. 1 mark for describing each function (any FIVE required)
Overall Performance	A significant majority of candidates performed well in describing the functions of the plasma membrane. However, some candidates struggled with the concept of phospholipid molecules' structure when placed in water.
Description of Better Responses	Candidates highlighted micelle aggregation and the bilayer structure, accurately explaining the arrangement of hydrophilic and hydrophobic ends. These answers exhibit a solid understanding of membrane organisation. Further, candidates provided comprehensive responses detailing the multifaceted functions of the plasma membrane. They aptly highlighted its selective permeability, cell signalling, transport mechanisms, structural support, recognition, and adhesion properties. Furthermore, candidates noted its role in regulating growth, protecting against harmful substances, maintaining water balance, and generating electrochemical gradients. They also acknowledged the membrane's contribution to excretion and responsiveness to external stimuli. These well-structured explanations showcase a solid understanding about the role of the plasma membrane in cellular processes.
Image of Better Response	 (a) (i) when phospholipid molecules are placed in water, the surface of phospholipid is hydrophobic at both ends and hydrophilic part is facing each other & between the hydrophobic surfaces. As hydrophobic is water hating region it will not react with water molecules but the hydrophillic part will make bond or react with water molecules. (ii) (a) Plasma membrane is selectively permeable membrane will allow the passage of material in and out of the cell. (b) Glycoproteins and Glycolipids present in plasma membrane act as cell surface markers. Plasma membrane provide space for antibodies or atigens and hormones to bind responsible for changes in body. (3) food particle is enter to cell through endocytosis and waste exist through exocytosis by plasma membrane. (4) Movement of ions is possible due to presence of carries proteins in plasma membrane. (5) lipids in phospholipid bilayer controls the fluidity of membrane hence plasma membrane maintain shape of cell.

Description of Weaker Responses	Weaker responses were irrelevant and did not fulfil the demand of the question. These responses indicated a poor understanding of the subject matter which shows a lack of comprehension of the specific concepts being asked and their inability to apply the relevant knowledge to the question. Candidates need to reinforce the foundational concepts and key points related to the topic.
Image of Weaker Response	

a (ii) Functions of plasma membrane.
① They have rigid surface.
② There particles are loosly packed.
③ They have no specific shape and volume They contain shape and volume of the container.
④ There gas particles are tightly packed.
⑤ plasma membrane is also present in gogli apparatus, proteins and lipids.

(i) The structure attained by phospholipid Molecules when they are placed in water the contain green algae and as well brown algae. because they contain chloroplast.

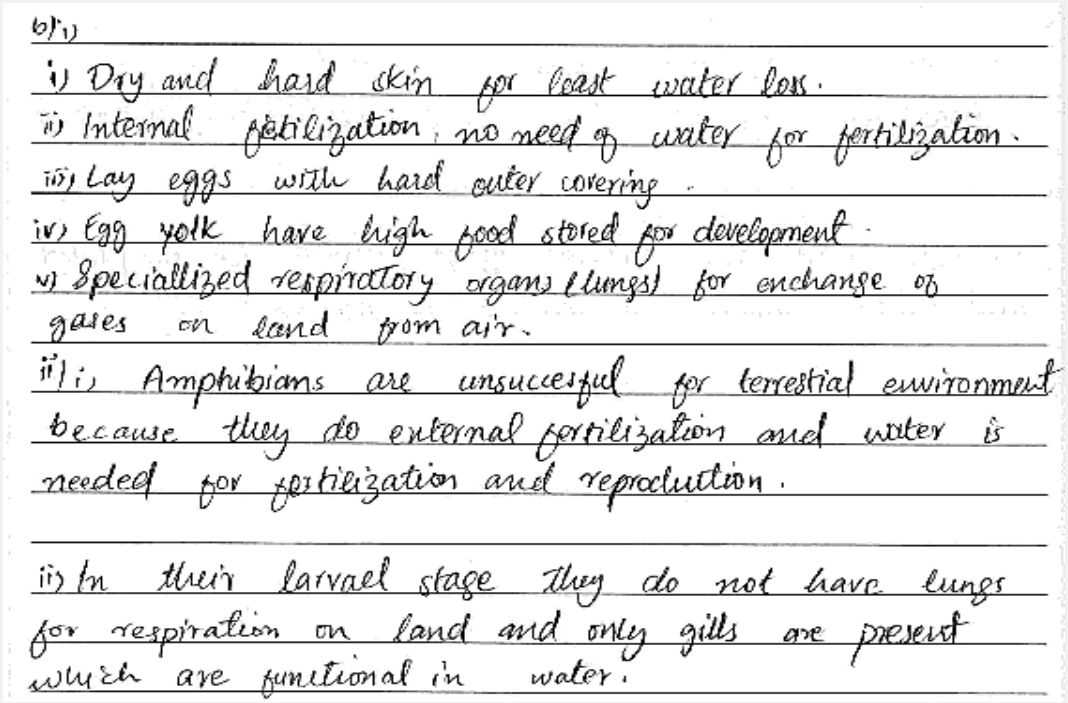
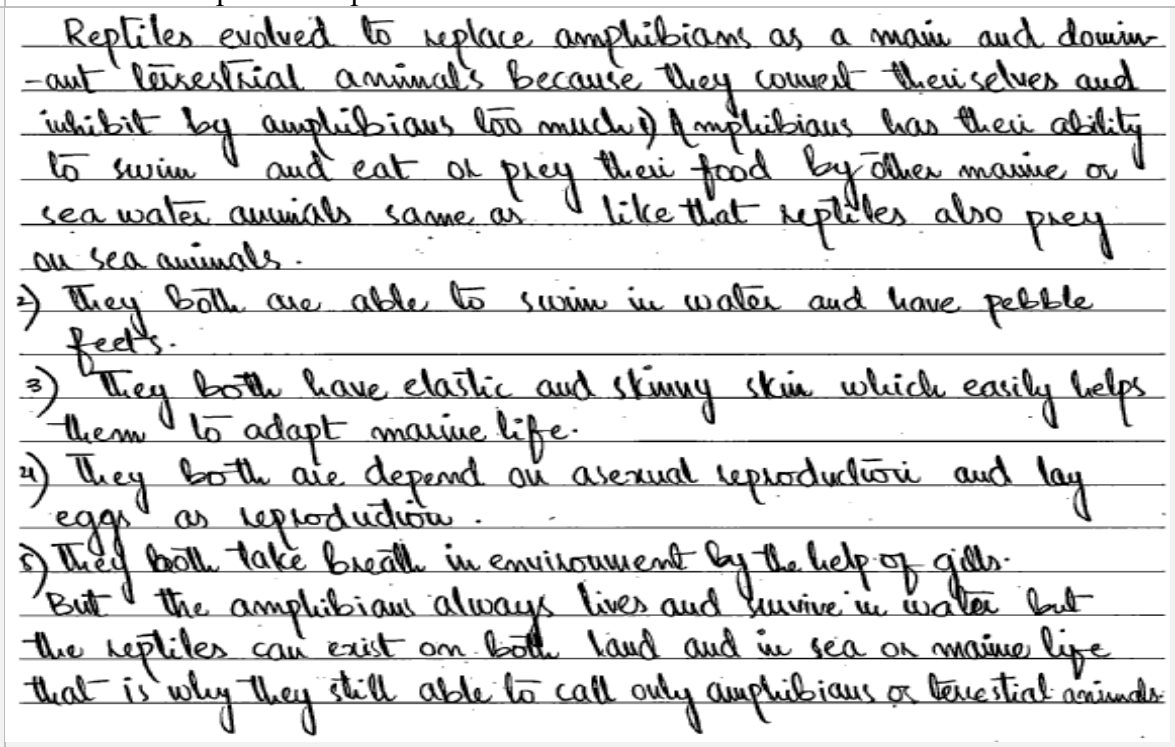
Suggestions for Improvement (Highlighted part)

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	• Storyboard • 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

• Refer to the resource guide for extra resources		

Any Additional Suggestion:
Teachers are advised to encourage candidates to think critically and analyse the question before responding. They should consider the key concepts and apply their knowledge to provide relevant answers. Furthermore, offer additional learning resources, such as readings, videos, or interactive materials, to supplement their understanding of the concept.

Question No. 10b	
Question Text	Reptiles have evolved to replace amphibians as dominant terrestrial animals. i. Describe any FIVE adaptive features of reptiles to the terrestrial environment. ii. Describe any TWO features of amphibians which limit their chances of survival in the terrestrial environment.
SLO No.	10.13.6 and 10.13.8
SLO Text	Discuss amphibians as unsuccessful land vertebrates. Discuss reptiles as successful land vertebrates.
Max Marks	7
Cognitive Level	U
Checking Hints	1 mark for describing each adaptive feature of reptiles to the terrestrial environment (any FIVE required). 1 mark for describing each feature of amphibians which limit their chances of survival in the terrestrial environment limitation (any TWO required).
Overall Performance	Majority of candidates performed well in the question and provided relevant information about the adaptive features of reptiles to the terrestrial environment. Additionally, accurately describing the features of amphibians that limit their chances of survival on land demonstrated a comprehensive understanding of the topic.
Description of Better Responses	Better responses adeptly highlighted adaptive features of reptiles on land, showcasing in-depth biological knowledge. The explanations effectively connected reptilian traits like scaly skin, efficient lungs and amniotic eggs to their terrestrial success. Likewise, the understanding of amphibian limitations such as moisture-dependent skin, aquatic egg deposition, and gill-reliant larvae reflects a comprehensive grasp of amphibian biology. These answers demonstrated a high level of comprehension and skill in relating anatomical and physiological adaptations to habitat preferences in both reptiles and amphibians.

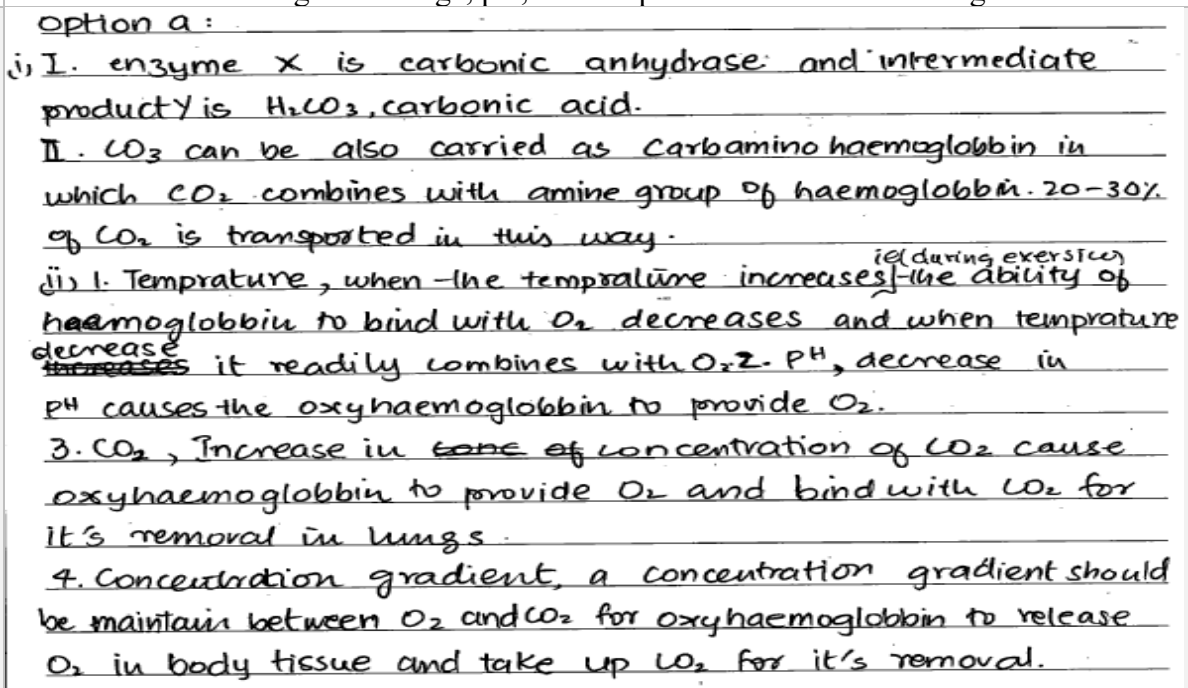
Image of Better Response	 b)i) i) Dry and hard skin for least water loss. ii) Internal fertilization, no need of water for fertilization. iii) Lay eggs with hard outer covering. iv) Egg yolk have high food stored for development. v) Specialized respiratory organs (lungs) for exchange of gases on land from air. ii) i) Amphibians are unsuccessful for terrestrial environment because they do external fertilization and water is needed for fertilization and reproduction. ii) In their larval stage they do not have lungs for respiration on land and only gills are present which are functional in water.
Description of Weaker Responses	Some responses were tangential and failed to address the question's requirements, indicating a weak grasp of the topic. Candidates struggled to apply relevant concepts, resulting in overly generalised answers. This suggests a lack of comprehension and an inability to effectively apply their knowledge to specific contexts. Encouraging candidates to focus on precise connections between reptile and amphibian characteristics and their habitat adaptations is essential for improved responses.
Image of Weaker Response:	 Reptiles evolved to replace amphibians as a main and dominant terrestrial animals because they convert themselves and inhibit by amphibians too much) Amphibians has their ability to swim and eat or prey their food by other marine or sea water animals same as like that reptiles also prey on sea animals. 2) They both are able to swim in water and have pebble feets. 3) They both have elastic and skinny skin which easily helps them to adapt marine life. 4) They both are depend on asexual reproduction and lay eggs as reproduction. 5) They both take breath in environment by the help of gills. But the amphibians always lives and survive in water but the reptiles can exist on both land and in sea or marine life that is why they still able to call only amphibians or terrestial animals

Suggestions for Improvement (Highlighted part)

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	• Storyboard • 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 are advised to offer timely and constructive feedback on weaker responses, pointing out areas of improvement and providing additional resources or support to help candidates address their shortcomings.

Question No. 11a	
Question Text	i. The following chemical pathway shows how carbon dioxide is converted into bicarbonate in a red blood cell. $CO_2 + H_2O \xrightarrow{\mathbf{X}} \mathbf{Y} \longrightarrow H^+ + HCO_3^-$ I. Identify enzyme **X** and intermediate product **Y**. II. Name any ONE form, other than HCO3−, in which CO_2 is carried in the blood. ii. Describe any FOUR factors that cause dissociation of oxyhaemoglobin to provide oxygen to the actively respiring tissues of the human body.
SLO No.	13.3.4

SLO Text	Explain transportation of carbon dioxide and oxygen by the blood.
Max Marks	7
Cognitive Level	U
Checking Hints	i. 1 mark for identifying **X** as carbonic anhydrase 1 mark for identifying intermediate product **Y** as carbonic acid/ H2CO3 ii. 1 mark for naming the forms i.e., dissolved in plasma / as carbamino compounds / as carbaminohaemoglobin iii. 1 mark for describing each factor causing dissociation of oxyhaemoglobin as follows (any FOUR required) (**Note**: 1 mark will be awarded if a candidate mentions only three factors without providing any description)
Overall Performance	Most of the candidates performed creditably on this question, indicating a high level of preparation and understanding of the topic. The fact that they were well prepared suggests that they had a good grasp of the subject matter and were able to apply their knowledge effectively. Additionally, their practice of past paper questions likely played a crucial role in their success, as it would have allowed them to familiarise themselves with the format and types of questions they might encounter in the actual exams.
Description of Better Responses	Better responses demonstrated a precise application of the provided information, correctly identifying enzyme **X** as carbonic anhydrase and intermediate product **Y** as carbonic acid (H_2CO_3) in the reaction. Moreover, candidates accurately discussed the role of lower oxygen partial pressure, elevated carbon dioxide levels leading to carbaminohaemoglobin formation, and the influence of pH on oxyhaemoglobin release. They further explained the carbonic acid dissociation mechanism and haemoglobinic acid's contribution. Additionally, candidates recognised the impact of temperature on haemoglobin's oxygen-carrying capacity. These explanations showcased an in-depth understanding of respiratory physiology, illustrating connections between gas exchange, pH, and temperature effects on haemoglobin's function.
Image of Better Response	

option a:

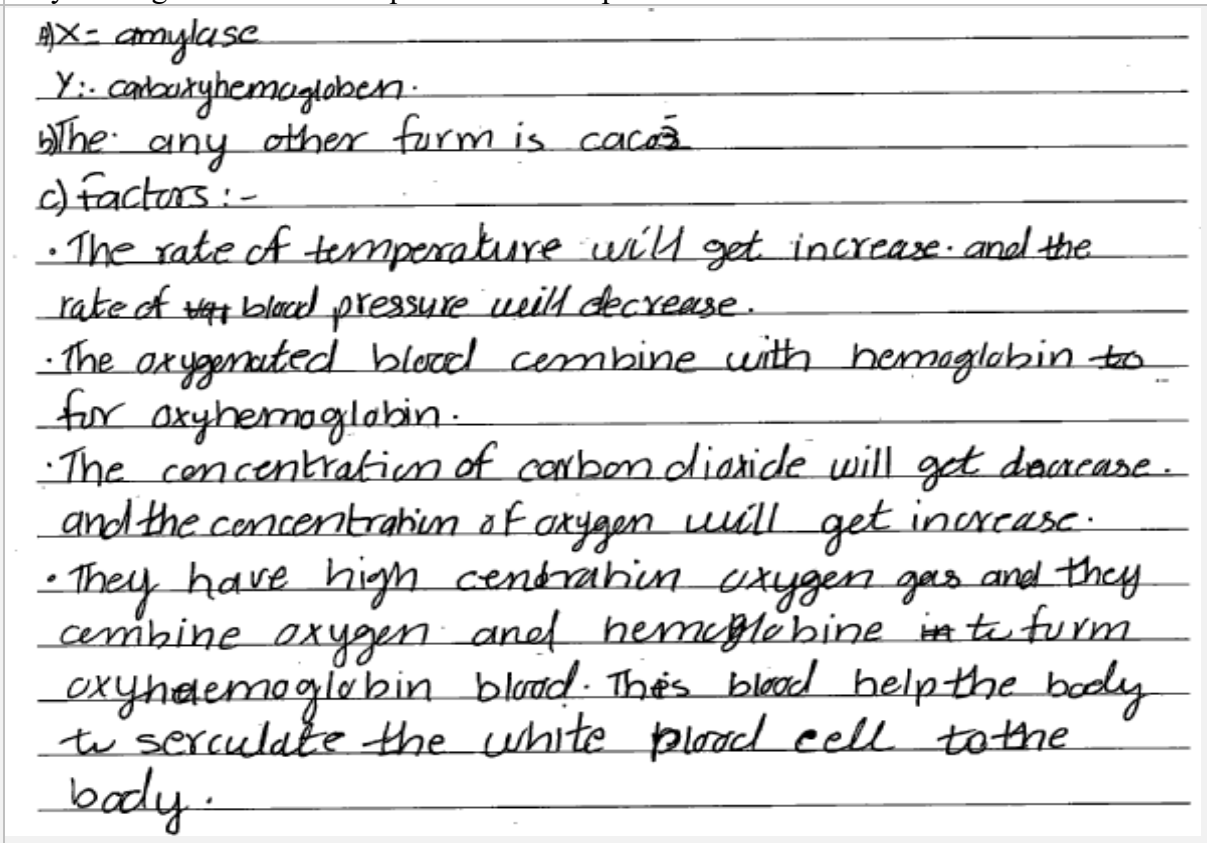
i) I. enzyme X is carbonic anhydrase and intermediate product Y is H_2CO_3, carbonic acid.

II. CO_2 can be also carried as carbamino haemoglobbin in which CO_2 combines with amine group of haemoglobbin. 20-30% of CO_2 is transported in this way.

ii) I. Temprature, when the temprature increases (ie during exercise) the ability of haemoglobbin to bind with O_2 decreases and when temprature decrease ~~increases~~ it readily combines with O_2. 2. PH, decrease in PH causes the oxyhaemoglobbin to provide O_2.

3. CO_2, Increase in ~~rate~~ of concentration of CO_2 cause oxyhaemoglobbin to provide O_2 and bind with CO_2 for it's removal in lungs.

4. Concentration gradient, a concentration gradient should be maintain between O_2 and CO_2 for oxyhaemoglobbin to release O_2 in body tissue and take up CO_2 for it's removal.

Description of Weaker Responses	Weaker responses displayed inaccurate utilisation of the given stimulus, failing to identify enzyme **X** (carbonic anhydrase) and intermediate product **Y** (carbonic acid/ H_2CO_3) of the reaction correctly. Moreover, these responses provided incorrect or incomplete names for the forms (other than HCO^{3-}) in which CO_2 is transported in the blood, neglecting to mention options such as dissolved in plasma, carbamino compounds, and carbaminohaemoglobin. Additionally, the explanations regarding the factors responsible for the dissociation of oxyhaemoglobin were inadequate in these responses.
Image of Weaker Response	

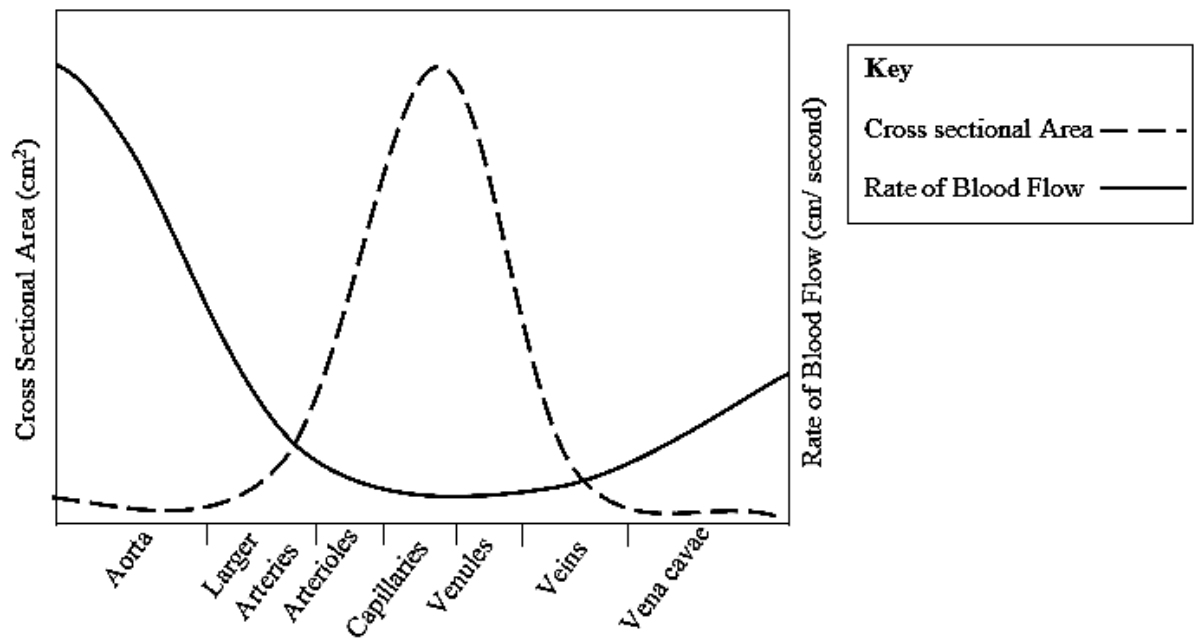
a) X = amylase
Y: carboxyhemoglobin.
b) The any other form is $CaCO_3$
c) factors :-
• The rate of temperature will get increase. and the rate of ~~the~~ blood pressure will decrease.
• The oxygenated blood combine with hemoglobin ~~to~~ for oxyhemoglobin.
• The concentration of carbon dioxide will get decrease. and the concentration of oxygen will get increase.
• They have high centration oxygen gas and they combine oxygen and hemoglobine ~~in~~ to form oxyhaemoglobin blood. This blood help the body to serculate the white blood cell to the body.

Suggestions for Improvement (Highlighted part)

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	• Storyboard • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual Resources • Think, Pair and Share • Knowledge Platform Videos	• Past paper questions • Discussion on E-Marking Notes • AKU-EB Digital Learning Solution powered by Knowledge Platform https://akueb.knowledgeplatform.com/login

required like analysing or evaluating) • Go through the past paper questions on that particular concept • Refer to the resource guide for extra resources	• Questioning Technique (Socratic Approach) • Practical Demonstration	

Any Additional Suggestion:
Teachers are advised to provide candidates with a range of practice questions including past paper questions related to the topic. This practice will enhance their problem-solving skills and reinforce their knowledge.

Question No. 11b	
Question Text	The given graph shows the relationship between the cross-sectional area and the rate of blood flow in different blood vessels of human body.  i. Why does the rate of blood flow gradually decrease from aorta to capillaries? ii. Describe any FOUR factors that cause the gradual increase of blood flow from the veins to vena cava. iii. Identify the blood vessel which has the highest cross-sectional area. Support your answer by giving a reason.
SLO No.	14.7.8
SLO Text	Differentiate among artery, vein and capillary on the basis of their structure and function.
Max Marks	7
Cognitive Level	U
Checking Hints	i. 1 mark for the correct reason (ONE required). ii. 1 mark for describing each factor (any FOUR required). iii. 1 mark for the correct identification. 1 mark for the correct reason.
Overall Performance	A significant number of candidates showcased their better aptitude for critical thinking and proficiency in analysing the information presented in the stimulus. Their ability to interpret and assess the given data indicates a higher level of cognitive skills, allowing them to draw well-reasoned conclusions and make informed judgments based on the provided information.
Description of Better Responses	Better responses underscored candidates' analytical ability, crucial in both academic and professional contexts. Regarding blood flow, candidates aptly recognised the relationship between velocity and vessel cross-sectional area. They pinpointed that decreased velocity stems from capillary bed expansion, showcasing their grasp of blood flow dynamics. Moreover, candidates cogently outlined factors driving increased blood flow toward the vena cava, i.e., reduced cross-sectional area, skeletal muscle contraction, smooth muscle activity including breathing, and semilunar valve action. This reflects comprehensive insight into venous blood flow regulation.

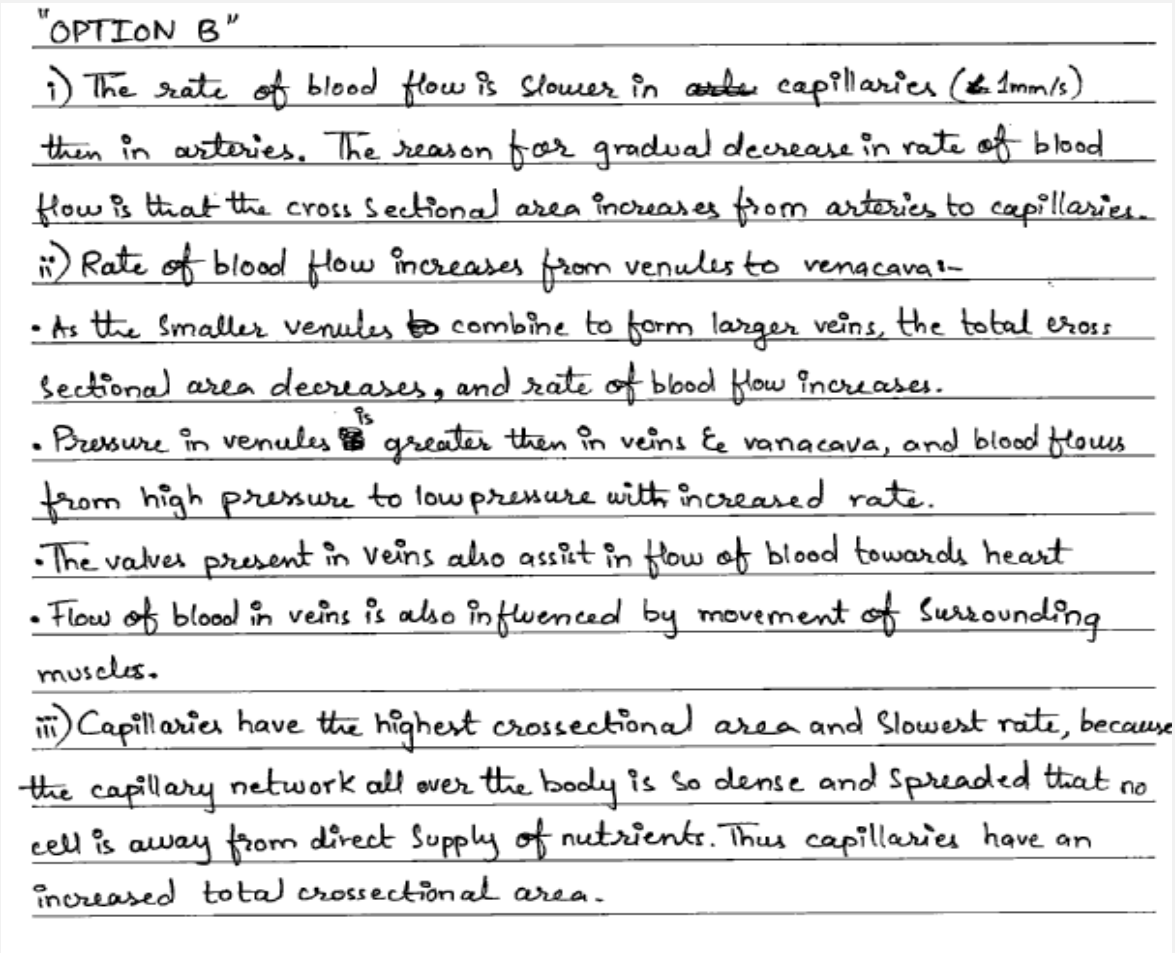
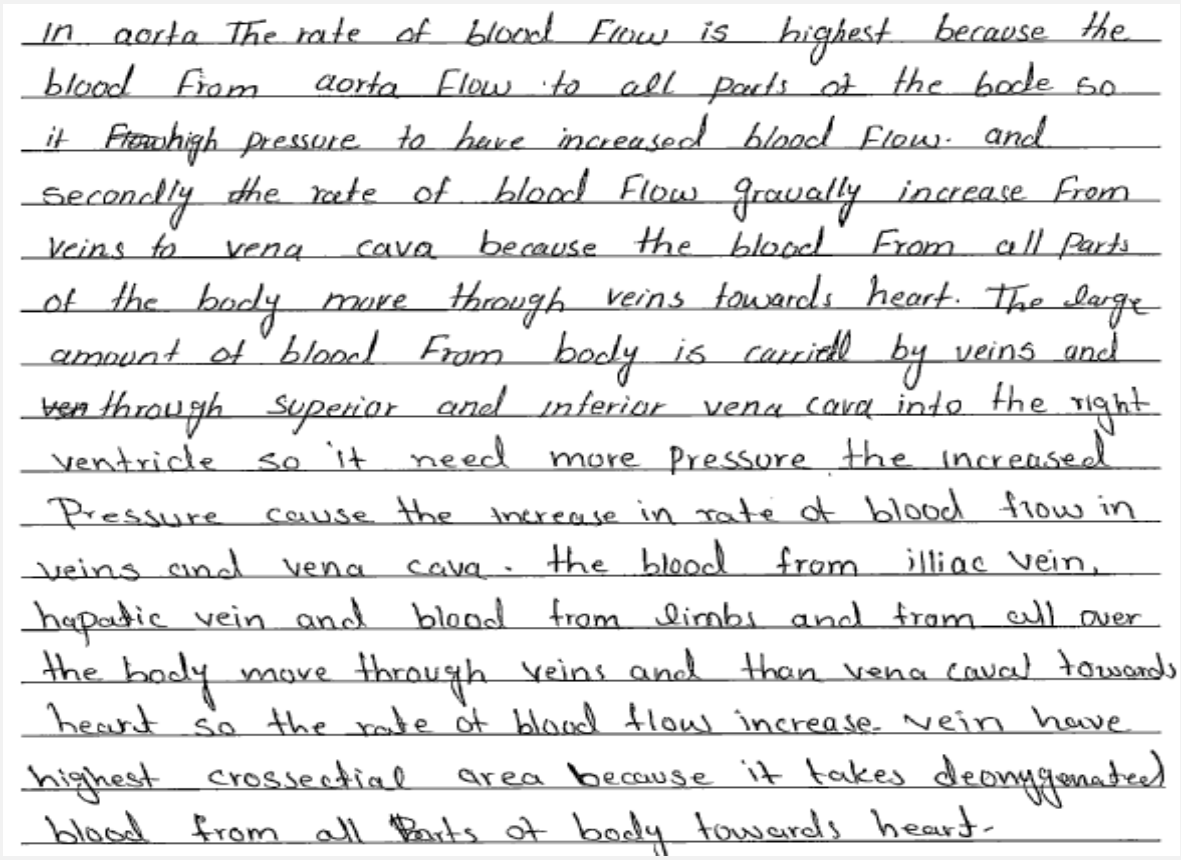
	Correctly identifying capillaries as having the highest cross-sectional area, candidates justified this with capillaries' role as crucial exchange sites between blood and tissue cells.
Image of Better Response	 "OPTION B" i) The rate of blood flow is slower in capillaries (≤ 1mm/s) than in arteries. The reason for gradual decrease in rate of blood flow is that the cross sectional area increases from arteries to capillaries. ii) Rate of blood flow increases from venules to venacava:- • As the smaller venules combine to form larger veins, the total cross sectional area decreases, and rate of blood flow increases. • Pressure in venules is greater than in veins & venacava, and blood flows from high pressure to low pressure with increased rate. • The valves present in veins also assist in flow of blood towards heart • Flow of blood in veins is also influenced by movement of surrounding muscles. iii) Capillaries have the highest crossectional area and slowest rate, because the capillary network all over the body is so dense and spreaded that no cell is away from direct supply of nutrients. Thus capillaries have an increased total crossectional area.
Description of Weaker Responses	Regarding blood flow, these responses inaccurately explained the gradual decrease in velocity, reflecting a lack of comprehension of blood flow dynamics. Inadequate descriptions of factors governing venous blood flow, like cross-sectional area reduction, muscle contraction, and valve action, underscore incomplete understanding. Further errors in identifying vessel cross-sectional area and failing to justify it showcased a flawed grasp of circulatory principles. These responses collectively exposed a deficiency in analytical skills, which may hinder their ability to comprehend complex concepts and physiological mechanisms.

Image of Weaker Response:


In aorta The rate of blood Flow is highest because the blood From aorta Flow to all parts of the bode so it ~~Flow~~high pressure to have increased blood Flow. and secondly the rate of blood Flow gravally increase From veins to vena cava because the blood From all Parts of the body move through veins towards heart. The large amount of blood From body is carridd by veins and ~~ven~~ through superior and inferior vena cava into the right ventricle so it need more pressure the increased Pressure cause the increase in rate of blood flow in veins and vena cava. the blood from illiac vein, hapatic vein and blood from limbs and from all over the body move through veins and than vena caval towards heart so the rate of blood flow increase. vein have highest crossectial area because it takes deoxygenated blood from all Parts of body towards heart.

Suggestions for Improvement (Highlighted part)

How to Approach SLO	Pedagogy Used for that SLO	Assessment Strategies
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that particular concept • Refer to the resource guide for extra resources		
Any Additional Suggestion: Teachers can present students with hypothetical scenarios related to blood flow dynamics and ask them to analyse and solve these problems. This approach encourages critical thinking and reinforces the application of theoretical 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 Biology HSSC-I E-Marking Notes.

We extend our sincere appreciation to Ms Sajida Mohammed Afzal, Specialist Curriculum and Examination Development AKU-EB, for taking subject lead during the entire process of E-marking.

We particularly thank to Ms Musarrat Jabeen Lubna, Principal Marker, Habib Public 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.

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