AGA KHAN UNIVERSITY EXAMINATION BOARD

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

Introduction

This document has been prepared for the teachers and candidates of Higher Secondary School Certificate (HSSC) Part II (Class XII) Biology. It contains comments on candidates' responses to the 2023 HSSC-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 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 demands of the questions, often misinterpreting the command words and the stimuli. Furthermore, interpretation of graphs and scientific reasoning were also weak. Mentioned below are a few concepts that teachers need to focus so that the candidates may perform better.

- Analyse data to make predictions, decisions or draw conclusions
- Effect of nicotine as a stimulant on synaptic transmission
- Understanding of gene linkage and its impact on the independent assortment of alleles during crossing over
- Gastrulation in chick's embryo
- Phenylketonuria as a genetic disease
- DNA fingerprinting

However, candidates outperformed in some concepts, such as, thermoregulatory adaptations in plants, exemplifying the type of joints in human body, assessing the number of chromosomes at different stages of mitosis and meiosis, polymerase chain reaction, functions of liver and urea cycle and difference between the working of sympathetic and parasympathetic nervous systems.

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

DETAILED COMMENTS
Constructed Response Questions (CRQs)

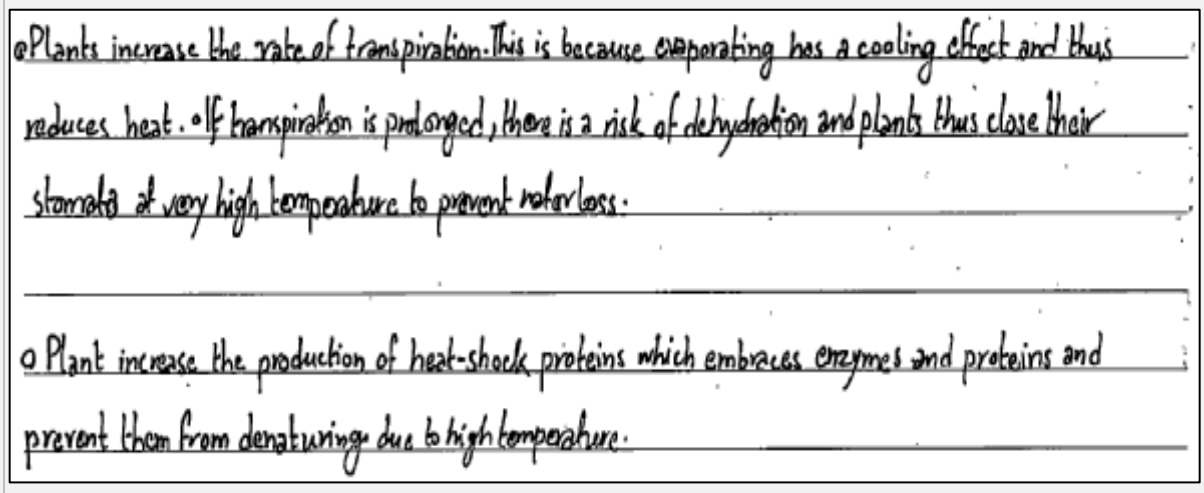
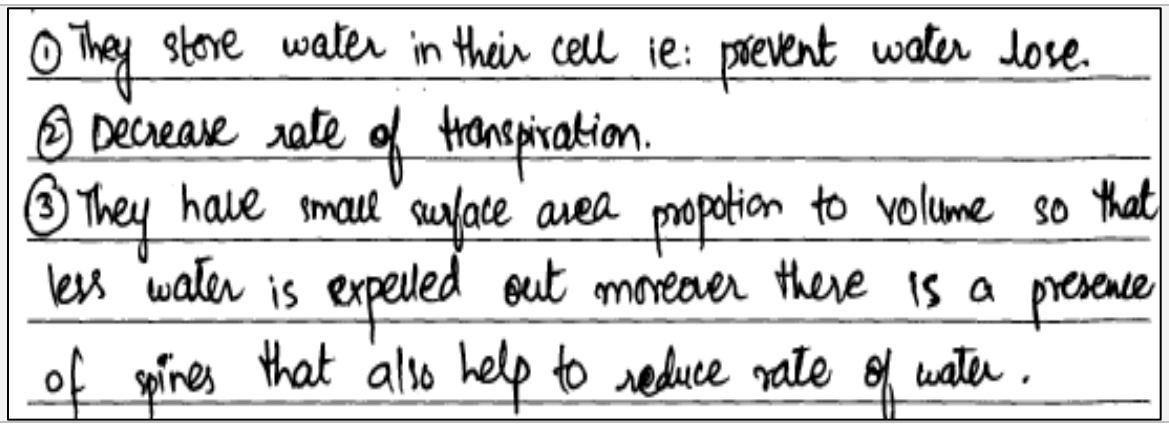
Question No. 1	
Question Text	Describe any THREE thermoregulatory adaptations in plants to high temperature.
SLO No.	15.8.1
SLO Text	Describe adaptations of plants to low and high temperature.
Max Marks	3
Cognitive Level	U*
Checking Hints	1 mark for describing each adaptation (THREE required)
Overall Performance	Overall, the performance of candidates in this question was very good, with most of them scoring well. This question served as an accessible starting point for the exam paper, allowing all candidates, including those with lower abilities, to secure some marks at the beginning of the examination. However, there were a few candidates who faced challenges in accurately describing the thermoregulatory adaptations of plants at higher temperatures.
Description of Better Responses	Better responses accurately described the relevant thermoregulatory adaptations of plants to cope with high environmental temperatures. These responses acknowledged that plants in temperate regions face temperatures of 40°C and above synthesise heat-shock proteins to prevent enzyme denaturation. Additionally, they explained how plants use evaporative cooling and excessive transpiration to manage high temperatures. In hot and dry weather, these responses noted that plants close their stomata to prevent excessive water loss. These insightful answers demonstrate a strong understanding of the topic and effectively convey the thermoregulatory adaptations that plants employ to deal with high temperatures.
Image of Better Response	
Description of Weaker Responses	Weaker responses indicated that many candidates lack basic knowledge about the function of stomata and struggled to comprehend the term “thermoregulatory adaptations.” Gaining a solid foundation of these concepts will enable candidates to provide accurate and informed responses in similar questions. Some candidates provided irrelevant responses, indicating a lack of basic knowledge about the concept of thermoregulation in plants. This suggests a gap in their understanding of the topic and may require further study and clarification.

Image of Weaker Response	

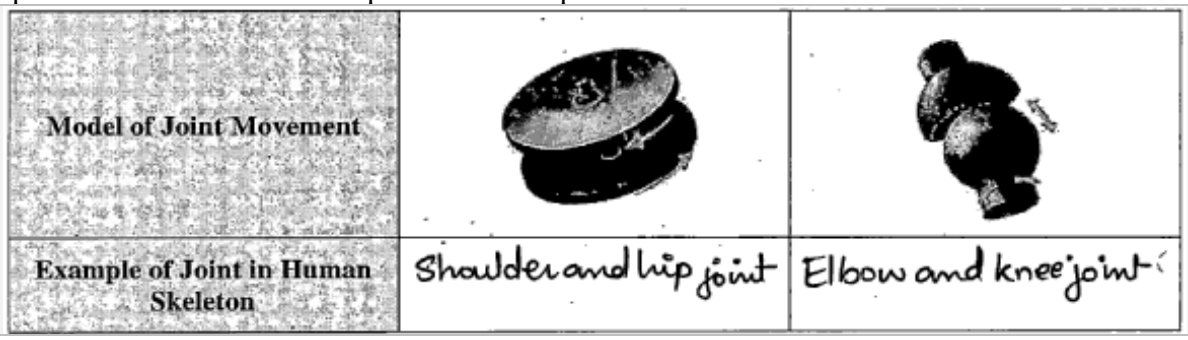
Suggestions for Improvement (Highlighted part)

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 ** For description of each pedagogy, refer to Annexure A	• Past paper questions • Discussion on E-Marking Notes • AKU-EB Digital Learning Solution powered by Knowledge Platform https://akueb.knowledgeplatform.com/login

Any Additional Suggestion:
Encourage classroom discussions and reflections on thermoregulation in plants. Ask open-ended questions to promote critical thinking and encourage students to share their observations and insights.

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

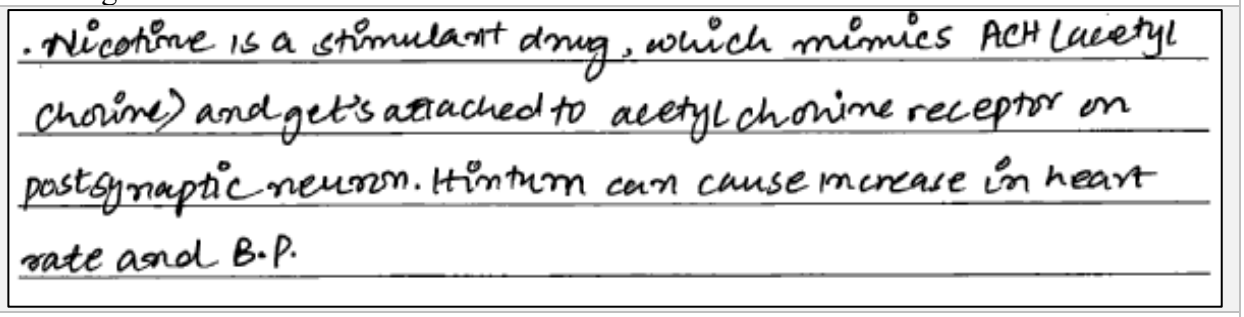
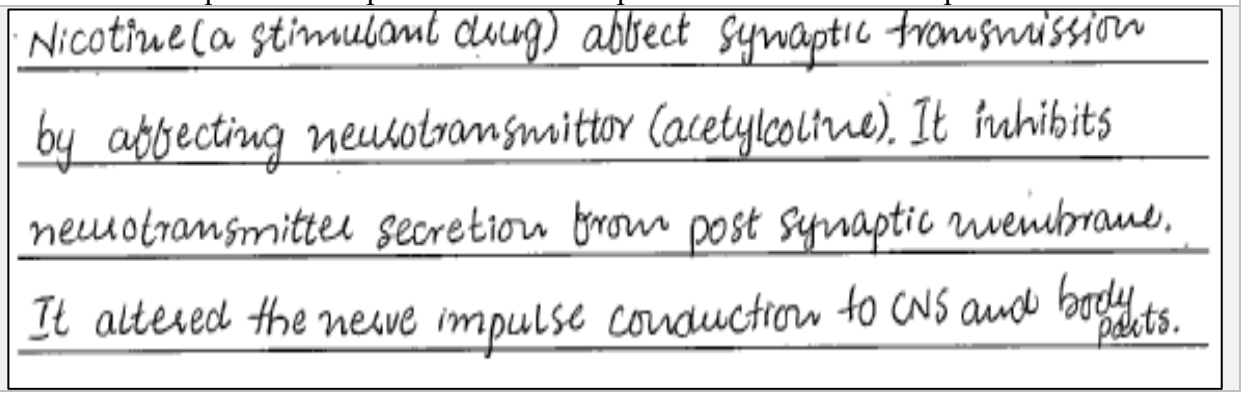
<table>
<tr><th colspan="2">Question No. 2</th></tr>
<tr><td>Question Text</td><td>Exemplify any ONE joint of the human skeleton for each of the given models of joint movement.
<table>
<tr><td>Model of Joint Movement</td><td>  </td><td>  </td></tr>
<tr><td>Example of Joint in Human Skeleton</td><td></td><td></td></tr>
</table></td></tr>
<tr><td>SLO No.</td><td>16.4.4</td></tr>
<tr><td>SLO Text</td><td>Describe joints (articulation) and its types with examples</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 giving each example (TWO required)</td></tr>
<tr><td>Overall Performance</td><td>In this question, a significant portion of the candidates scored 50% as they faced difficulty in providing examples of pivot joints in the human body. However, they were able to correctly exemplify ball and socket joints. It is important to note that many candidates only identified the type of joint, such as pivot joint or ball and socket joint, without providing specific examples of these joints in the human body. This shows a weaker understanding of the command word, which requires the inclusion of relevant and specific examples.</td></tr>
<tr><td>Description of Better Responses</td><td>Better responses in this question employed the use of diagrams to effectively exemplify the different types of joints found in the human body. They correctly identified and showcased the presence of pivot joints between the skull and atlas joint as well as in the proximal radioulnar joint. Furthermore, they highlighted ball and socket joints in the shoulder and hip joints. By employing visual representations, these candidates effectively communicated their knowledge and demonstrated their understanding of the topic at hand.</td></tr>
<tr><td>Image of Better Response</td><td>
<table>
<tr><td>Model of Joint Movement</td><td>  </td><td>  </td></tr>
<tr><td>Example of Joint in Human Skeleton</td><td>Joint between atlas and axis (First pair of vertebrae)</td><td>Shoulder joint</td></tr>
</table>
</td></tr>
</table>

Description of Weaker Responses	Weaker responses struggled to provide examples for both pivot joints and ball and socket joints in the human body. Mostly, candidates were unable to exemplify pivot joints, focusing primarily on hinge and ball and socket joints instead. Additionally, some candidates only identified the type of joints without providing specific examples, indicating a weaker understanding of the command word and the requirement to provide relevant examples. For further improvement, candidates should ensure they grasp the concept of different joint types and their corresponding examples in the human body, enabling them to respond accurately to questions that demand examples based on specific illustrations
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 encouraged to link the functioning of various types of human joints to real-life examples, such as the operation of a pivot joint. Additionally, they should highlight which joint or joints in the human body operate based on this principle. By relating these concepts to practical applications, they can enhance relevance and engagement for students.

Question No. 3	
Question Text	How does nicotine (a stimulant drug) affect synaptic transmission in humans?
SLO No.	17.4.7
SLO Text	Discuss effects of drugs (nicotine and caffeine) on nervous activity;
Max Marks	2
Cognitive Level	U
Checking Hints	1 mark for nicotine mimics excitatory neurotransmitters/ acetylcholine 1 mark for the effect i.e., increases depolarisation of post synaptic neuron which increases the generation of action potential
Overall Performance	Some of the candidates provided appropriate responses, indicating a solid insight of the concept. However, the remaining candidates demonstrated a weaker comprehension of the topic. While they had a basic knowledge that nicotine mimics or behaves like acetylcholine, they were unable to effectively relate this to synaptic transmission.
Description of Better Responses	Better responses demonstrated a clear understanding of the mechanism by which nicotine functions as a stimulant. These candidates accurately identified that nicotine acts by mimicking the excitatory neurotransmitter acetylcholine. They described that nicotine increases depolarisation of the postsynaptic neuron and promotes continuous nerve impulse transmission by opening the gates of sodium channels at the postsynaptic membrane. These insightful responses reflect a strong comprehension of how nicotine affects synaptic transmission and the resulting overstimulation of neurons.
Image of Better Response	
Description of Weaker Responses	Weaker responses deviated from the intended focus by discussing the effects of nicotine addiction and its symptoms on the human body, rather than describing its specific effect as a stimulant on synaptic transmission. Although some candidates appropriately recognised that nicotine mimics acetylcholine, they were unable to relate this to its impact on synaptic transmission. For further improvement, candidates should strive to understand the specific demand of the question and provide focused responses that address the topic at hand.
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 are highly recommended to offer additional resources, readings, or enrichment opportunities for students.		

Question No. 4

Question Text

Consider the given cross in *Drosophila* (Fruit flies).

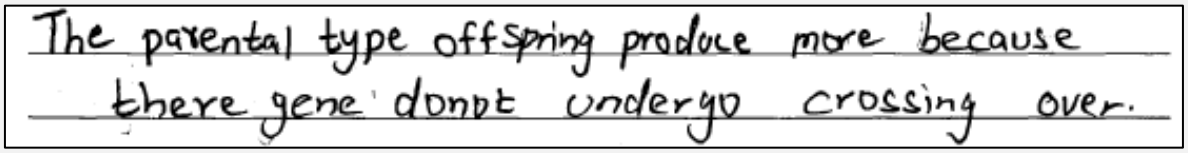
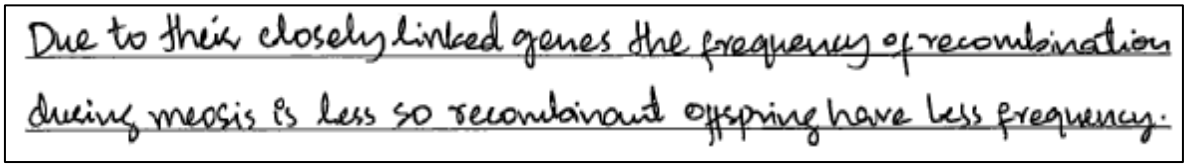
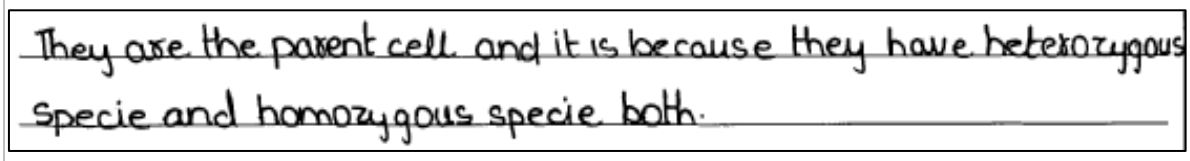
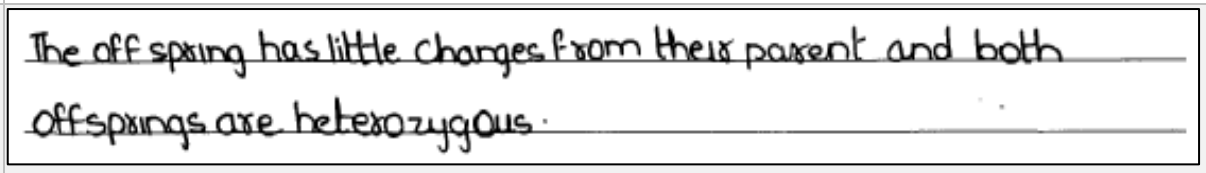
Phenotypes of Parents	Grey Body, Long Wings	×	Black Body, Short Wings
Genotypes of Parents	GGNN		ggnn
Genotypes of Offspring	GgNn		
Phenotypes of Offspring	All Grey Body, Long Wings		

The resulted offspring (GgNn) were then crossed with flies homozygous for black body and short wings (ggnn).
The obtained results are shown in the given table.

GgNn Crosses with ggnn				
	Grey Body and Long Wings	**Black Body and Short Wings**	**Grey Body and Short Wings**	**Black Body and Long Wings**
Number of Offspring	975	963	186	194

a. Why are the parental type offspring [(grey body, long wings) and (black body, short wings)] produced more in number?
b. Why are the recombinant offspring [(grey body, short wings) and (black body, long wings)] produced less in number?

SLO No.	22.2.3; 22.5.1
SLO Text	Illustrate Mendel's laws through genetic crosses. Describe linkage and crossing using the examples of drosophila.
Max Marks	2
Cognitive Level	A
Checking Hints	a. 1 mark for describing the reason b. 1 mark for describing the reason
Overall Performance	A small number of candidates provided accurate responses to the question. These candidates demonstrated a good understanding of the key information provided in the stimulus or stem, allowing them to appropriately formulate their answers. On the other hand, candidates who did not perform as well often struggled to comprehend the specific requirements of the question, resulting in missing important information provided in the stimulus or stem. Additionally, many students had difficulty relating the two concepts of gene linkage and Mendel's law of independent assortment.

Description of Better Responses	Candidates demonstrated a commendable understanding of gene linkage's impact on independent assortment. Their adept use of biological terminology underscores their grasp of the concept. Particularly in part "a", these responses accurately highlight how gene linkage inhibits crossing over during meiosis, leading to a higher frequency of parental types. In part "b", candidates adeptly apply Mendel's law of independent assortment to the scenario, explaining the reduced occurrence of recombinant offspring due to gene linkage. Their insightful interpretations and coherent descriptions underscore their solid comprehension of these genetic principles.
Image of Better Response 4a	
Image of Better Response 4b	
Description of Weaker Responses	Weaker responses revealed a misconception of Mendel's law of independent assortment. Many candidates struggled to properly utilise the given information and relate gene linkage to the law of independent assortment. Instead, they relied on memorised contexts of complete dominance and recessive inheritance, which were not applicable to the question. For further improvement, candidates should focus on understanding the principles of Mendelian genetics, including the law of independent assortment and gene linkage. By grasping these concepts and applying them accurately to specific scenarios, candidates can provide more precise and relevant responses.
Image of Weaker Response 4a	
Image of Weaker Response 4b	

Suggestions for Improvement (Highlighted part)

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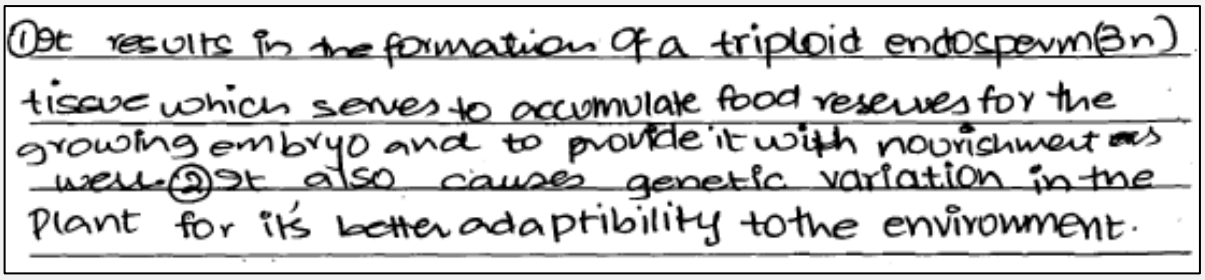
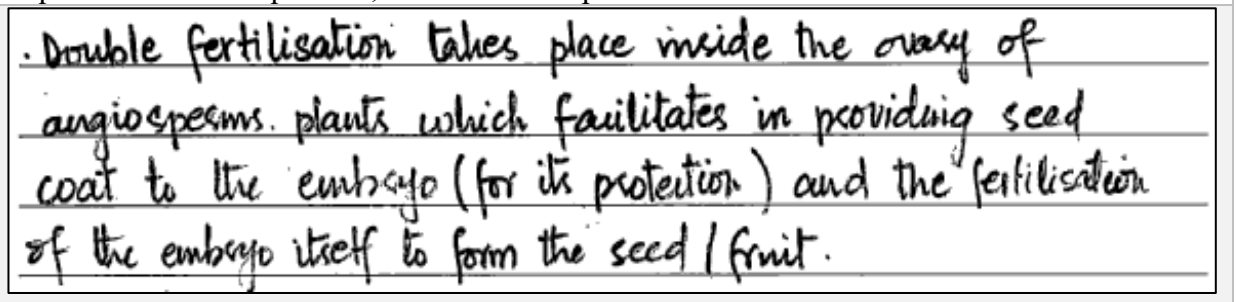
understanding of concepts and any skills that may be required like analysing or evaluating) • Go through the past paper questions on that particular concept • Refer to the resource guide for extra resources	• Think, Pair and Share • Knowledge Platform Videos • Questioning Technique (Socratic Approach) • Practical Demonstration	

Any Additional Suggestion:
Teachers are strongly recommended to emphasise on problem-solving skills by providing students with challenging gene linkage problems or scenarios. Encourage them to analyse the information provided, identify the linked genes, and predict the outcomes of genetic crosses based on gene linkage.

Question No. 5	
Question Text	Describe any TWO points of significances of double fertilisation in angiosperms.
SLO No.	18.3.4
SLO Text	Explain process of sexual reproduction in angiosperms.
Max Marks	2
Cognitive Level	U
Checking Hints	1 mark for each significance of double fertilisation in angiosperms
Overall Performance	A significant number of candidates scored well in this question, demonstrating a solid understanding of the concept of double fertilisation in angiosperms. However, it is worth noting that some candidates exhibited a weaker grasp of this concept. Additionally, there were instances of carelessness in reading and comprehending the question, resulting in confusion between the concept of double fertilisation in angiosperms and the production of identical and fraternal twins in humans. To improve, candidates should focus on studying and differentiating these concepts, ensuring they understand the specific context and requirements of each question before formulating their responses.
Description of Better Responses	Candidates exhibited a good grasp about the concept double fertilisation in angiosperms. They accurately detailed the formation of the zygote and endosperm, emphasising the endosperm's role in embryo nourishment. Notably, some responses extended their insights, recognising the transformative impact on fruit development and enhanced plant survival. These candidates showcased a thorough understanding of the concept's significance, illustrating how it shapes reproductive strategies in angiosperms.
Image of Better Response	 ①It results in the formation of a triploid endospevm(3n) tisaue which serves to accumulate food reseves for the growing embryo and to provide it with nourishment as well ②It also causes genetic variation in the plant for it's better adaptibility to the environment.
Description of Weaker Responses	Weaker responses in this question tended to provide irrelevant and generalised descriptions that did not directly address the specific demands of the question such as describing the development of fraternal or identical twins in humans. These responses demonstrated a lack of relevance to the topic and the specific question being asked. It is important to carefully analyse and understand what is being asked before formulating a response. By focusing on the specific requirements of the question, candidates can provide more accurate and relevant answers.
Image of Weaker Response	 . Double fertilisation takes place inside the ovary of angiospesms. plants which faulitates in providing seed coat to the embryo (for its protection) and the fertilisation of the embryo itself to form the seed / fruit.

Suggestions for Improvement (Highlighted part)

How to Approach SLO	Pedagogy Used for that SLO	Assessment Strategies
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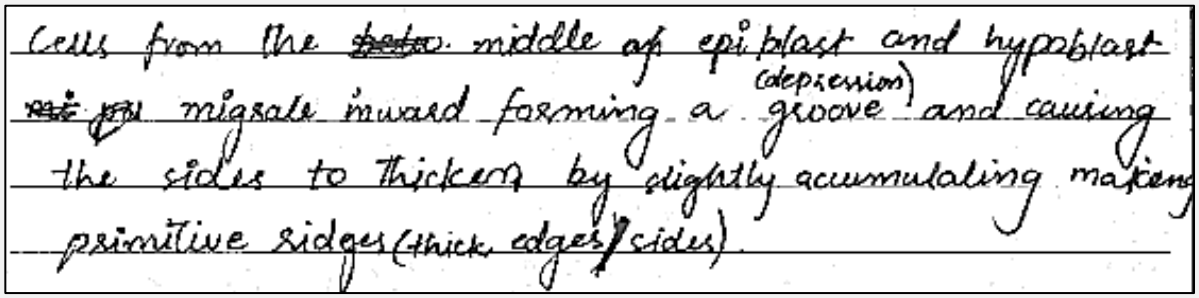
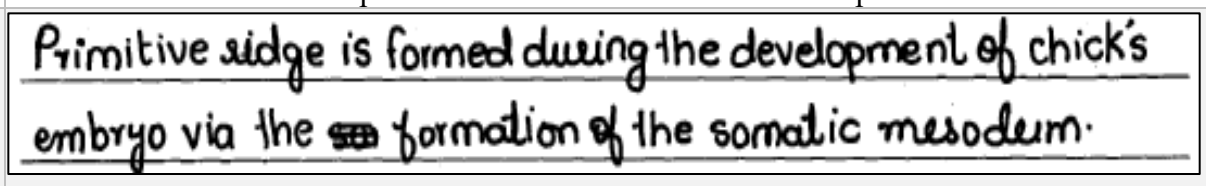
Any Additional Suggestion:
Teachers are advised to facilitate interactive discussions to promote student's engagement and understanding. Encourage students to ask questions, share their observations, and participate in group discussions about the significance and mechanisms of double fertilisation. This can help clarify misconceptions and deepen understanding.

Question No. 6	
Question Text	How is the primitive ridge formed during the development of chick's embryo?
SLO No.	19.5.4
SLO Text	Explain the stages of chick development, i.e., a. morula formation b. blastulation c. gastrulation d. notochord formation e. neurulation f. somites and coelom formation
Max Marks	2
Cognitive Level	U
Checking Hints	1 mark for describing the continuous migration of cells taking place between epiblast and hypoblast 1 mark for mentioning the formation of groove along the whole length of primitive streak OR for further describing that primitive streak/ groove is marked on either side by thickened margins called primitive ridges
Overall Performance	A considerable number of candidates successfully answered this question with a strong grasp of the concept of gastrulation in a chick's embryo. These responses showcased a sound understanding of the topic. However, it is important to acknowledge that gastrulation can be a complex and challenging concept for students to comprehend fully. As a result, most candidates struggled to provide accurate responses, resulting in irrelevant answers.
Description of Better Responses	Better responses accurately described the process of formation of the primitive streak and primitive ridges during the development of a chick's embryo. These candidates recognised that the migration of cells occurs between the epiblast and hypoblast layers, leading to the formation of a groove along the entire length of the primitive streak. Additionally, they correctly mentioned that the thickened margins flanking this groove are referred to as primitive ridges. By providing these details, these candidates demonstrated a solid understanding of the topic and effectively conveyed the key processes involved in embryonic development.
Image of Better Response	
Description of Weaker Responses	Weaker responses in this question displayed a lack of understanding regarding the process of formation of the primitive streak and primitive ridges during the development of a chick's embryo. These responses included irrelevant or incorrect information, indicating a weaker grasp of the topic. Candidates are recommended to gain a deeper understanding of these concepts which will enable them to provide more accurate and relevant responses in the future.
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 are advised to assign students the task of researching and presenting specific stages of embryological development to their peers. This promotes collaborative learning and allows students to develop their presentation and communication skills. Furthermore, provide additional resources that simplify the concept of gastrulation and offer clearer guidance to students.

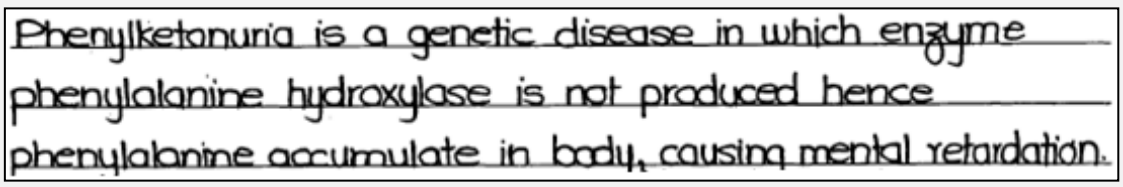
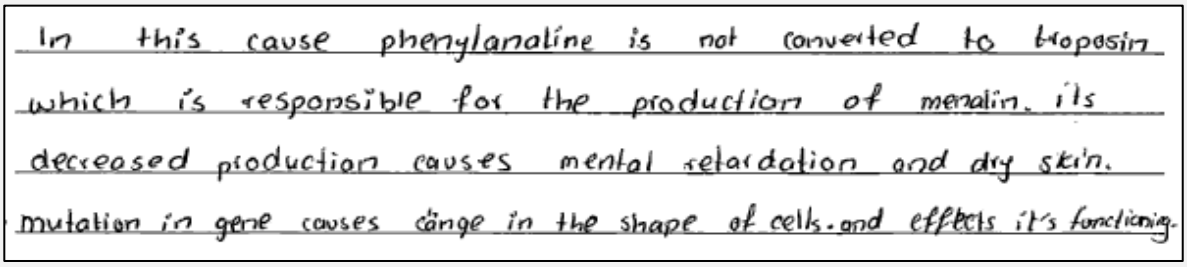
Question No. 7	
Question Text	Phenylketonuria is a genetic disease caused by gene mutation. In the human body, how does this gene mutation cause changes in the metabolism of body cells?
SLO No.	20.6.5
SLO Text	Describe sickle cell anaemia and phenylketonuria;
Max Marks	2
Cognitive Level	U
Checking Hints	1 mark for writing that mutated gene cannot make an enzyme called phenylalanine hydroxylase or PAH 1 mark for writing that this mutated/ defective enzyme causes buildup/ accumulation of phenylalanine up to harmful levels in the body. OR If PKU is not treated, phenylalanine can build up to harmful levels in the body which leads to mental retardation.
Overall Performance	A significant number of candidates provided correct answers to this question. However, some of the candidates confused the genetic disease being asked, phenylketonuria, with alkaptonuria, which is unrelated to the question's specific learning objective (SLO). As a result, their descriptions of alkaptonuria as the "black urine disease" were not relevant to the question's focus. To improve, candidates should carefully read and understand the question prompt, ensuring their responses align with the specific topic and requested information. Maintaining focus on the intended learning objectives will lead to more accurate and appropriate answers.
Description of Better Responses	Better responses demonstrated a strong understanding of the concept of gene mutation and its relationship to the formation of a defective enzyme, phenylalanine hydroxylase (PAH). These candidates effectively described the function of the enzyme, highlighting its role in converting phenylalanine into other necessary substances in the body. Furthermore, they recognised that the presence of the defective enzyme leads to the accumulation of phenylalanine to harmful levels, resulting in the development of mental retardation. These responses showcased a comprehensive understanding of the topic, connecting gene mutation, enzyme function, and the harmful consequences of enzyme deficiency.
Image of Better Response	
Description of Weaker Responses	Weaker responses demonstrated a lack of critical thinking and utilisation of the provided stimulus. Instead of intelligently using the information given, these responses often resorted to rephrase the question without providing relevant answers. Furthermore, some candidates mistakenly described alkaptonuria instead of addressing phenylketonuria, indicating a misunderstanding of the specific condition being asked. As a result, these responses did not fulfil the requirements of the question and were unable to achieve full marks. Candidates are advised that they should carefully analyse the given information and ensure that their responses are align with the specific topic and demand of the question.

Image of Weaker Response	 In this cause phenylanaline is not converted to tropasin which is responsible for the production of menalin. its decreased production causes mental retardation and dry skin. mutation in gene causes cange in the shape of cells. and effects it's functioning.

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 advised to foster inquiry-based learning by encouraging students to ask questions, explore their own lines of inquiry, and conduct investigations related to genetic diseases. This approach promotes active engagement and deeper understanding of the subject matter.

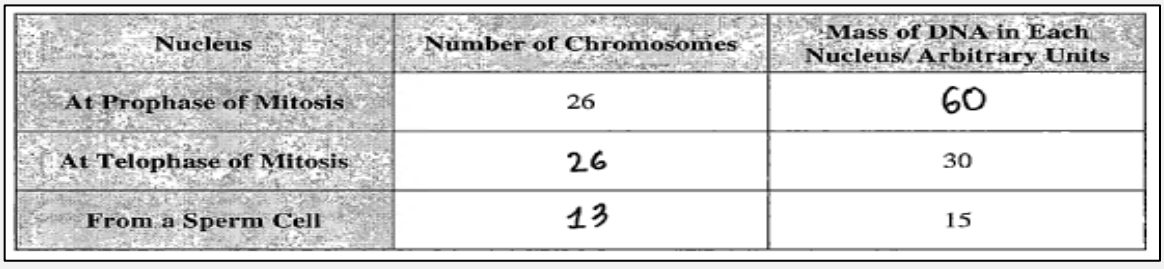
<table>
<tr><th colspan="2">Question No. 8</th></tr>
<tr><td>Question Text</td><td>The given table shows the number of chromosomes and the mass of DNA in different nuclei. All the nuclei come from the same animal.
Complete the missing information in the given table.
<table>
<tr><th>Nucleus</th><th>Number of Chromosomes</th><th>Mass of DNA in Each Nucleus/ Arbitrary Units</th></tr>
<tr><td>At Prophase of Mitosis</td><td>26</td><td></td></tr>
<tr><td>At Telophase of Mitosis</td><td></td><td>30</td></tr>
<tr><td>From a Sperm Cell</td><td></td><td>15</td></tr>
</table></td></tr>
<tr><td>SLO No.</td><td>21.2.2; 21.3.2</td></tr>
<tr><td>SLO Text</td><td>Describe different stages of mitosis.
Describe different stages of meiosis.</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 missing information (THREE required)</td></tr>
<tr><td>Overall Performance</td><td>Majority of the candidates accurately mentioned the number of chromosomes at telophase of mitosis and in a sperm cell, indicating a solid understanding of these concepts. However, there was a notable difficulty among most candidates in accurately stating the mass of DNA in each nucleus at prophase of mitosis. This suggests a gap in their understanding of DNA replication and the relationship between chromosome duplication and DNA mass during the S-phase of interphase.</td></tr>
<tr><td>Description of Better Responses</td><td>Candidates demonstrated good knowledge of mitotic and meiotic phases. They accurately delineated chromosome counts in prophase and telophase of mitosis, and correctly deduced the halving of chromosomes in sperm cells. Notably, their recognition of DNA doubling during the S-phase showcased a profound understanding of replication’s influence on chromatid formation. These responses exemplify a deep comprehension of cell division intricacies, emphasising chromosome behaviour and DNA dynamics.</td></tr>
<tr><td>Image of Better Response</td><td> 
<table>
<tr><th>Nucleus</th><th>Number of Chromosomes</th><th>Mass of DNA in Each Nucleus/ Arbitrary Units</th></tr>
<tr><td>At Prophase of Mitosis</td><td>26</td><td>60</td></tr>
<tr><td>At Telophase of Mitosis</td><td>26</td><td>30</td></tr>
<tr><td>From a Sperm Cell</td><td>13</td><td>15</td></tr>
</table></td></tr>
<tr><td>Description of Weaker Responses</td><td>Weaker responses displayed inaccuracies in describing the number of chromosomes and the mass of DNA at different phases of mitosis and meiosis. These responses were often unable to provide the correct number of chromosomes, and consequently, they also struggled with accurately stating the mass of DNA. Candidates with weaker understanding of the concept that DNA is duplicated during the S-phase of interphase and exists as sister chromatids in prophase of mitosis were unable to score full marks.</td></tr>
</table>

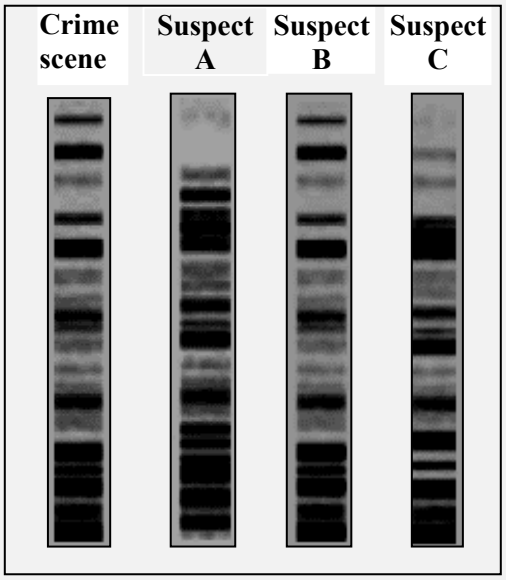
Image of Weaker Response

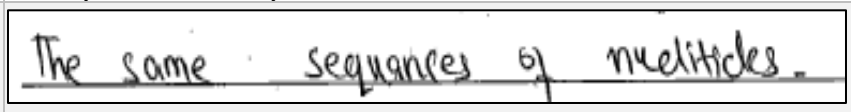
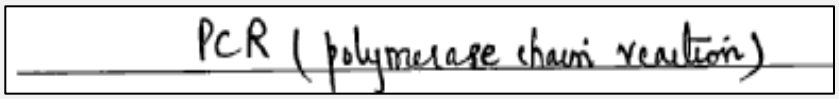
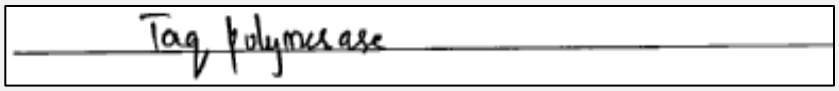
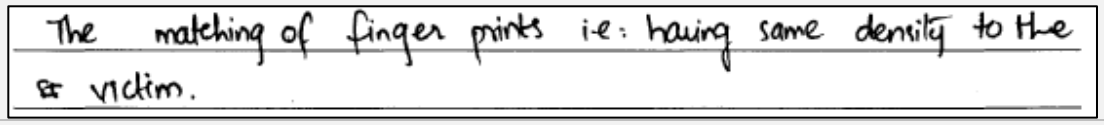
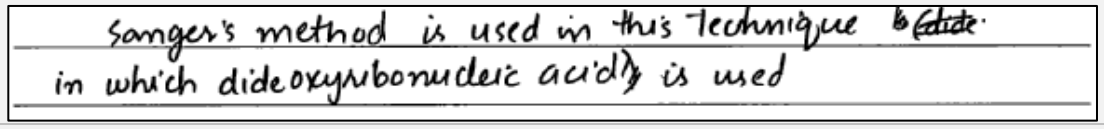
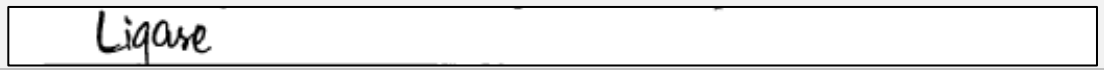
Nucleus	Number of Chromosomes	Mass of DNA in Each Nucleus/ Arbitrary Units
At Prophase of Mitosis	26	30
At Telophase of Mitosis	26	30
From a Sperm Cell	13	15

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 may use formative assessments such as quizzes, worksheets, or concept mapping exercises to monitor student progress and understanding of this concept. These assessments can help identify areas of misconception or confusion, allowing for timely intervention and clarification.

Question No. 9	
Question Text	Given are the DNA fingerprints of a sample of DNA collected from a crime scene which belongs to three suspects, **A**, **B** and **C**.  a. Which feature of the DNA fingerprint would lead to the identification of suspect **B** as being present at the site of the crime? b. DNA at crime scenes is often found in very small masses. Mention the technique that amplifies the DNA to enable their analysis. c. Name the enzyme used in the technique mentioned in part 'b'.
SLO No.	23.3.1
SLO Text	Describe the applications of : a. polymerase chain reaction b. DNA fingerprinting.
Max Marks	3
Cognitive Level	U
Checking Hints	a. 1 mark for writing same/ matching nucleotide sequences of DNA/ that contained repeating patterns as found at crime scene b. 1 mark for writing Polymerase Chain Reaction (PCR) c. 1 mark for writing Taq polymerase/ DNA polymerase/ polymerase
Overall Performance	Many of the candidates responded accurately in part 'b' and 'c' of the question, showcasing a solid understanding of the concepts related to DNA analysis techniques. However, in part 'a', the candidates' performance was average. Many of them focused on restating the identification of the suspect, as already provided in the question, rather than addressing the specific DNA feature that led to the identification. To improve their performance, candidates should pay close attention to the specific demands of the question and provide a focused response that highlights the relevant DNA feature used for identification.
Description of Better Responses	Candidates showcased good analytical skills by accurately connecting DNA fingerprinting to suspect B's identification. Their grasp of unique nucleotide sequences and their role in establishing individual identity demonstrated a profound understanding of the technique's principles. In part 9(b), their recognition of PCR as the amplification method highlighted solid comprehension. Furthermore, correctly identifying the Taq polymerase enzyme in part 9(c)

	underscored their knowledge of key genetic engineering components. These responses exemplify a comprehensive understanding of DNA analysis techniques and genetic manipulation concepts.
Image of Better Response 9a	
9b	
9c	
Description of Weaker Responses	Weaker responses displayed confusion about DNA structure's relevance to DNA fingerprinting, often rephrasing the stem without meaningful connections. Confusions between terms like "codons" and "DNA fingerprinting" revealed conceptual gaps. In part (b), candidates' failure to mention Polymerase Chain Reaction (PCR) as the amplification technique indicated a lack of knowledge. Similarly, in part (c), candidates struggled to name DNA polymerase or Taq polymerase as the enzyme used in PCR, signalling a misunderstanding of genetic engineering basics. Strengthening conceptual foundations is vital for precise and informed responses in DNA analysis and genetic manipulation.
Image of Weaker Response 9a	
9b	
9c	

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	• 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	(Socratic Approach) • Practical Demonstration	
Any Additional Suggestion: Teachers may assign case studies or research projects that require students to investigate real-life examples of DNA fingerprinting. This can enhance critical thinking skills and provide a deeper understanding of the concepts and their practical applications.		

Extended Response Questions (ERQs)

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

Question No. 10a	
Question Text	i. Describe any FOUR functions of liver other than bile production and deamination in the human body. ii. Identify any THREE substances required to initiate the urea cycle in liver
SLO No.	15.6.2; 15.6.3
SLO Text	Explain role of liver in urea formation (urea cycle or ornithine cycle). Discuss the role of liver in homeostasis.
Max Marks	7
Cognitive Level	U
Checking Hints	i. 1 mark for describing each function (FOUR required) 1 mark if only two functions are listed not described ii. 1 mark for identification of each substance (THREE required)
Overall Performance	An impressive majority of candidates demonstrated better performance in this question. Their understanding of the functions of the liver and the urea cycle was excellent. Notably, some candidates went above and beyond by creating labelled diagrams to illustrate the substances required to initiate the urea cycle in the liver. This level of detail showcases their comprehensive knowledge and ability to visually represent complex concepts.
Description of Better Responses	Better responses showcased a comprehensive grasp of the liver's multifaceted functions. Candidates accurately detailed carbohydrate metabolism processes like glycogenesis, glycolysis, and gluconeogenesis, while also explaining fat metabolism's conversion to fatty acids and cholesterol synthesis. Their inclusion of detoxification, storage of vitamins, and plasma protein synthesis highlighted holistic understanding. The accurate description of haemoglobin breakdown and the role in red blood cell production further demonstrated knowledge. Additionally, candidates linked liver functions to thermoregulation and urea cycle initiation, explaining ammonium ion reactions with precision. These responses reflect a deep comprehension of the liver's pivotal role in metabolism and overall homeostasis.

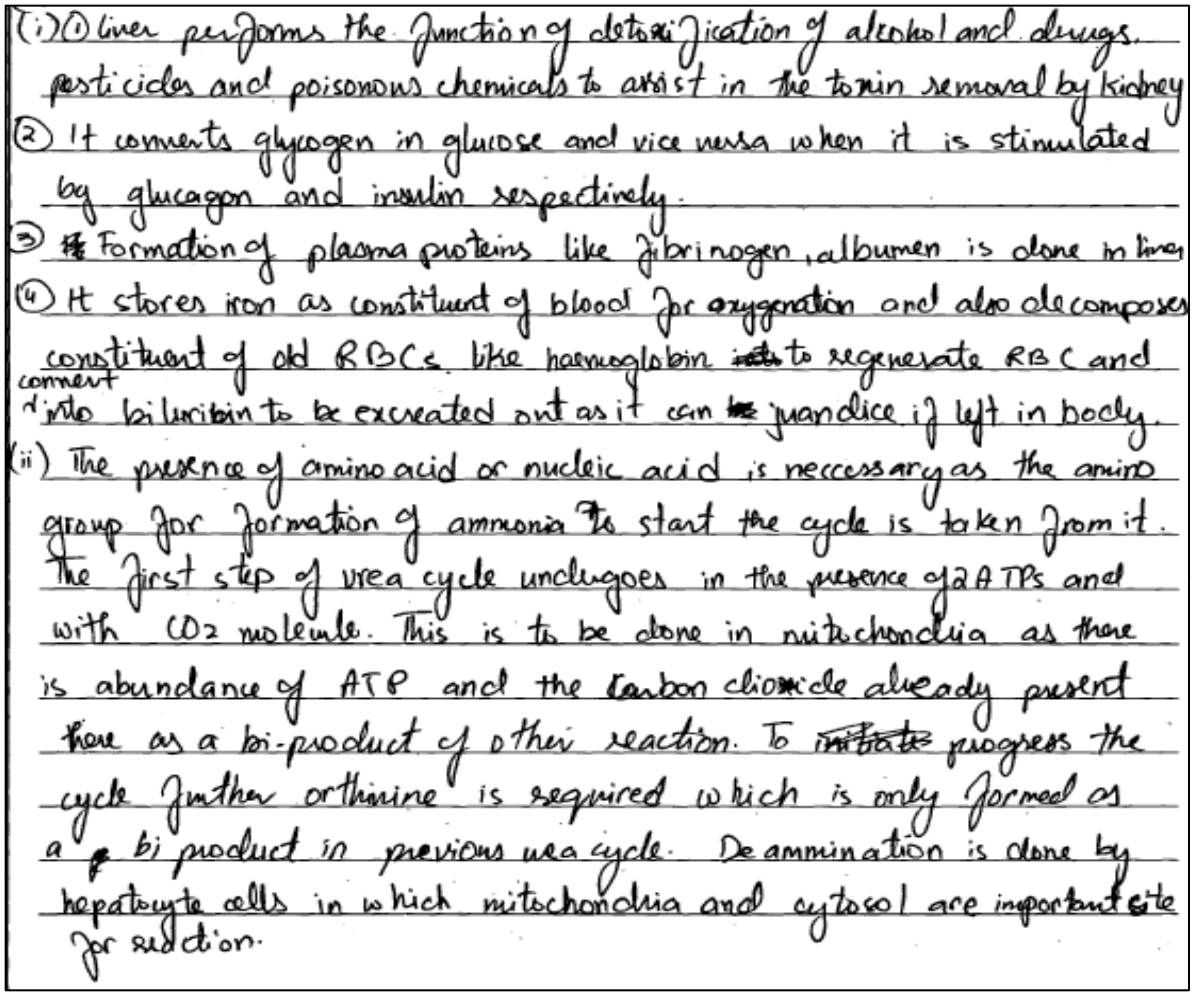
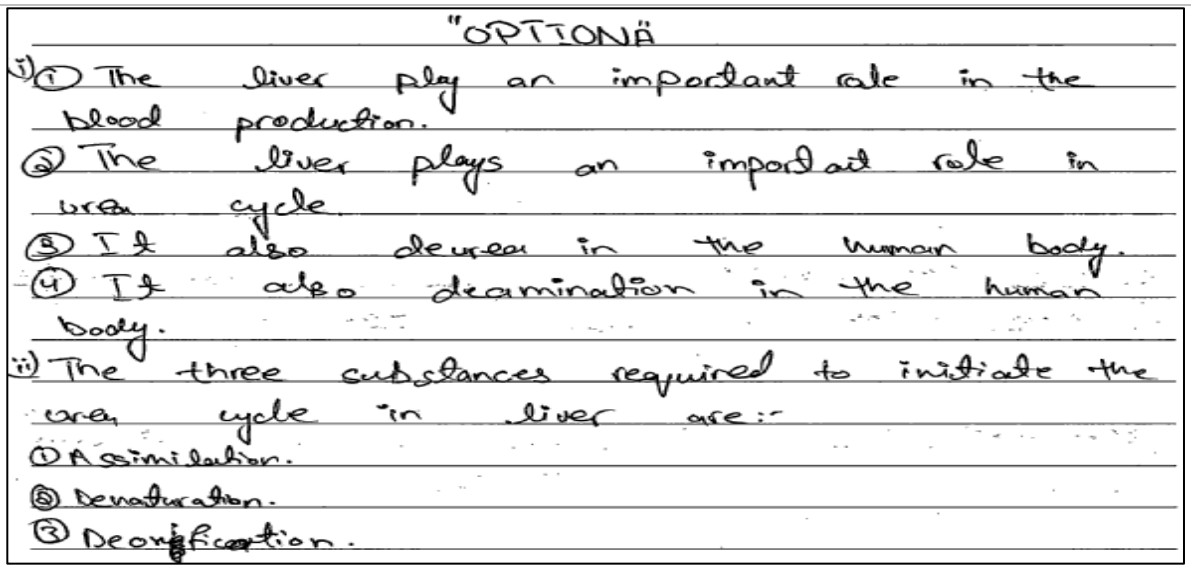
Image of Better Response	 (i) (1) Liver performs the function of detoxification of alcohol and drugs, pesticides and poisonous chemicals to assist in the toxin removal by kidney (2) It converts glycogen in glucose and vice versa when it is stimulated by glucagon and insulin respectively. (3) Formation of plasma proteins like fibrinogen, albumen is done in liver (4) It stores iron as constituent of blood for oxygenation and also decomposes constituent of old RBCs like haemoglobin to regenerate RBC and convert into bilirubin to be excreated out as it can be jaundice if left in body. (ii) The presence of amino acid or nucleic acid is necessary as the amino group for formation of ammonia to start the cycle is taken from it. The first step of urea cycle undergoes in the presence of 2 ATPs and with CO_2 molecule. This is to be done in mitochondria as there is abundance of ATP and the carbon dioxide already present there as a bi-product of other reaction. To progress the cycle further orthinine is required which is only formed as a bi product in previous urea cycle. Deamination is done by hepatocyte cells in which mitochondria and cytosol are important site for reaction.
Description of Weaker Responses	Weaker responses displayed a lack of attention to detail while reading and comprehending the question. Instead of providing a description of the concept asked, these responses merely restated the information already provided in the question. In the second part of the question, candidates struggled to mention more than one or two substances necessary for initiating the urea cycle. Furthermore, there was a notable deficiency in knowledge regarding the role of ATP in the urea cycle. To improve, candidates should focus on carefully understanding the question and expanding their knowledge on the specific concepts required to provide accurate and comprehensive responses.

Image of Weaker Response	

"OPTIONA

i) ① The liver play an important role in the blood production.
② The liver plays an imporatnt role in urea cycle.
③ It also deurea in the human body.
④ It also deamination in the human body.

ii) The three substances required to initiate the urea cycle in liver are:-
① Assimilation.
② Denaturation.
③ Deonification.

Suggestions for Improvement (Highlighted part)

How to Approach SLO	Pedagogy Used for that SLO	Assessment Strategies
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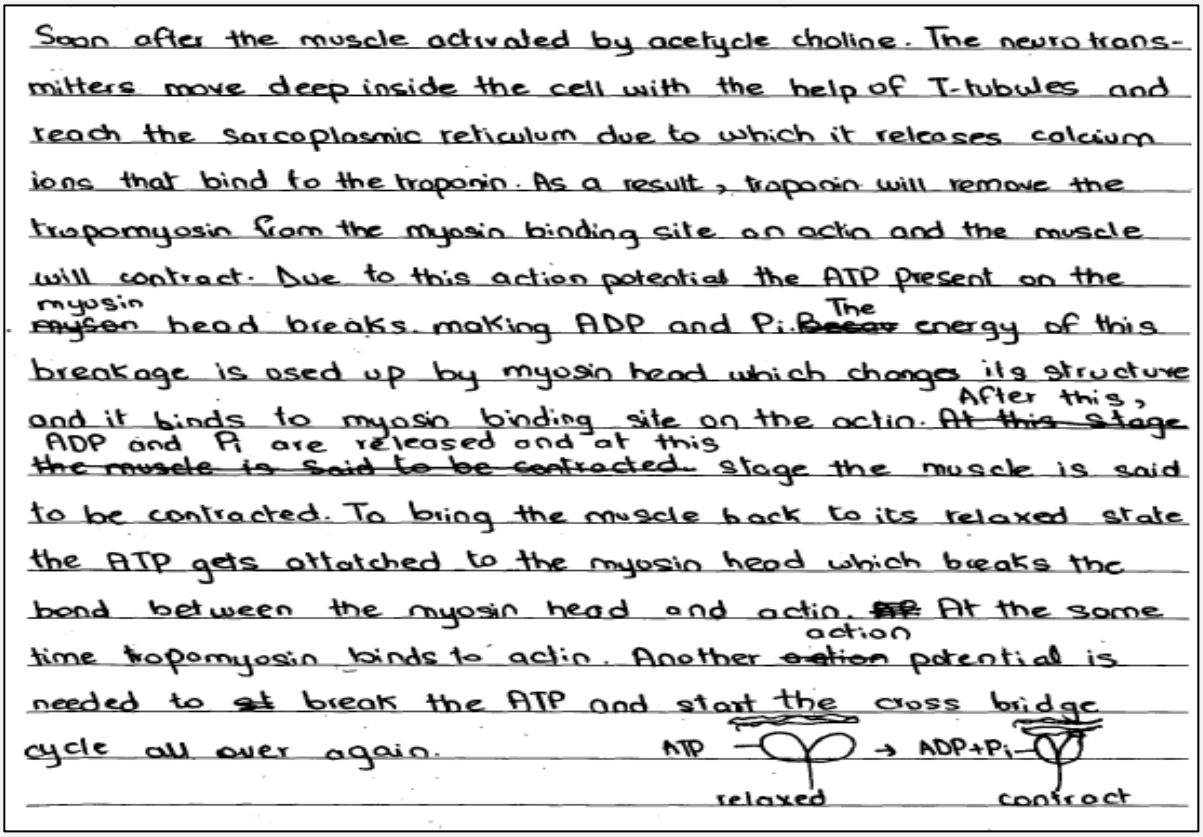
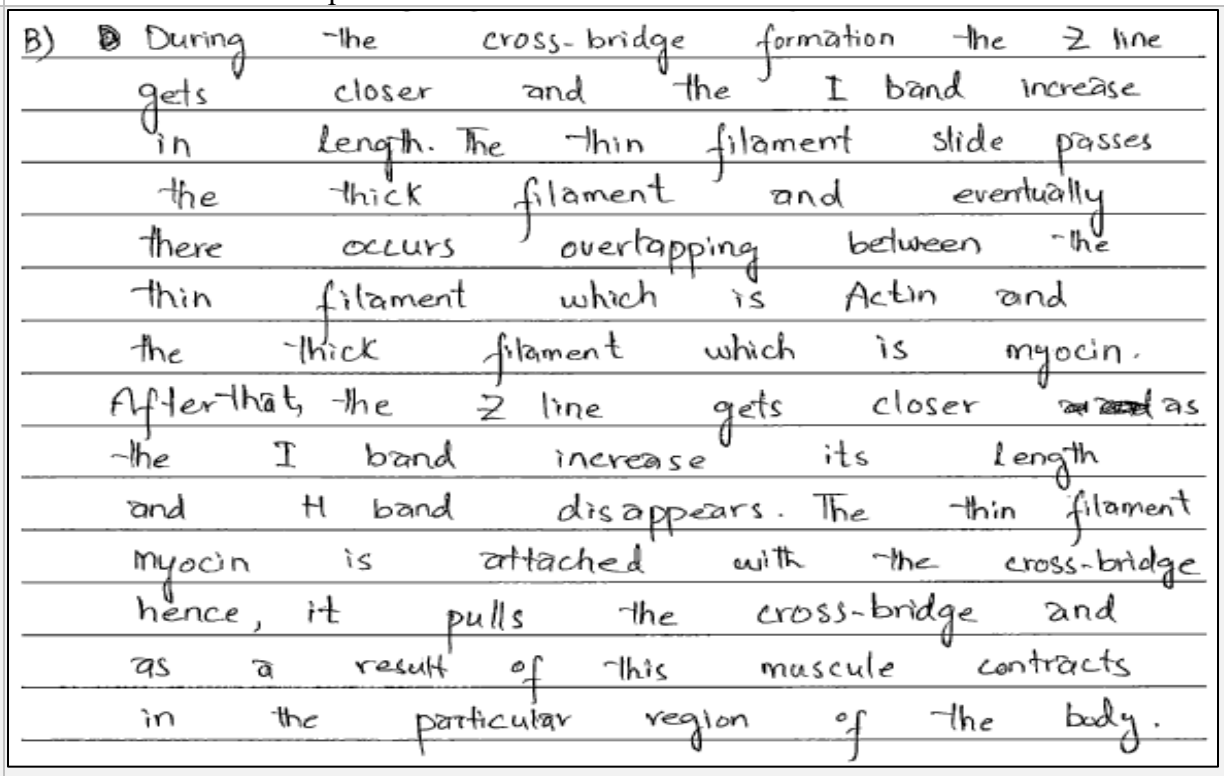
Any Additional Suggestion:
Teachers are advised to assist interactive discussions to promote student engagement and understanding. Encourage students to ask questions, share their observations, and participate in group discussions about the functions of liver in human body. This can help clarify misconceptions and deepen understanding.

Question No. 10b	
Question Text	Explain cross-bridge formation between actin and myosin during muscular contraction when a muscle fibre is activated by acetyl choline in the human body.
SLO No.	16.5.5
SLO Text	Explain the mechanism of muscle contraction (sliding filament theory of Huxley, cross bridge cycle and regulation of muscle contraction.
Max Marks	7
Cognitive Level	U
Checking Hints	1 mark each for writing each point (any SEVEN required)
Overall Performance	Majority of the cohort displayed a good understanding of the sliding filament theory of muscle contraction. However, there was a notable lack of description regarding the role of ATP in this mechanism. Many candidates mistakenly focused on the structure of the muscle fibre instead of addressing formation of cross bridge and the specific role of ATP in this cross-bridge cycle.
Description of Better Responses	Better responses showcase a comprehensive understanding of muscle contraction mechanisms. Candidates adeptly detail the entire process: acetylcholine activation, Ca^{++} release, actin-myosin cross-bridge formation, ATP's pivotal role, and its hydrolysis for energy release, leading to the power stroke's actin filament pull. Clear elucidation of ADP release, ATP binding, and the sliding mechanism's role highlights profound comprehension. The articulate explanation reflects proficiency of the complex interplay between molecular components, revealing a deep grasp of muscle physiology.
Image of Better Response	

Soon after the muscle activated by acetycle choline. The neuro trans-
mitters move deep inside the cell with the help of T-tubules and
reach the sarcoplasmic reticulum due to which it releases calcium
ions that bind to the troponin. As a result, troponin will remove the
tropomyosin from the myosin binding site on actin and the muscle
will contract. Due to this action potential the ATP present on the
myosin
~~myosin~~ head breaks. making ADP and Pi. The ~~Break~~ energy of this
breakage is used up by myosin head which changes its structure
and it binds to myosin binding site on the actin. ~~At this stage~~ After this,
ADP and Pi are released and at this
~~the muscle is said to be contracted.~~ stage the muscle is said
to be contracted. To bring the muscle back to its relaxed state
the ATP gets attatched to the myosin head which breaks the
bond between the myosin head and actin. ~~At~~ At the same
time tropomyosin binds to actin. Another ~~action~~ action potential is
needed to ~~at~~ break the ATP and start the cross bridge
cycle all over again.

Description of Weaker Responses	Weaker responses demonstrated difficulty in explaining the steps of cross-bridge formation during muscle contraction. Instead, these weaker responses focused on describing the structure of the sarcolemma rather than addressing its function as required. To improve, it is recommended to carefully understand the question before formulating the response, ensuring that the answer directly addresses the specific topic being asked. This approach will lead to more accurate and relevant explanations.
Image of Weaker Response	

B) During the cross-bridge formation the Z line gets closer and the I band increase in length. The thin filament slide passes the thick filament and eventually there occurs overlapping between the thin filament which is Actin and the thick filament which is myocin. After that, the Z line gets closer as the I band increase its length and H band disappears. The thin filament myocin is attached with the cross-bridge hence, it pulls the cross-bridge and as a result of this muscule contracts in the particular region of the body.

Suggestions for Improvement (Highlighted part)

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• Refer to the resource guide for extra resources		

Any Additional Suggestion:
Teachers are advised to utilise virtual simulations or online interactive resources that allow students to explore the sliding filament theory and manipulate the components involved in muscle contraction. This provides a virtual hands-on experience and enhances understanding.

Question No. 11a	
Question Text	The given diagram depicts a stressful condition where a dog is running after an officer. After running for 20 minutes, the officer is rescued and hence, he hence gets out of this stressful condition.  i. Describe the effects of stimulations of sympathetic nervous system on the liver, cardiac muscles, pancreas and adrenal medulla of the officer. ii. Describe any THREE roles of parasympathetic nervous system in the relaxed situation when the officer is rescued.
SLO No.	17.4.6
SLO Text	Differentiate between sympathetic and parasympathetic nervous system;
Max Marks	7
Cognitive Level	U
Checking Hints	1 mark for describing the effect of sympathetic nervous system on each effector (FOUR required) 1 mark for describing the role of parasympathetic nervous system (THREE required)
Overall Performance	A tremendous majority of candidates demonstrated better performance in this question. Their understanding of body responses controlled by the sympathetic and parasympathetic nervous systems was commendable. A significant proportion of candidates exhibited a remarkably high level of understanding, showcasing their strong grasp of the topic. Their responses effectively highlighted the distinct functions and effects produced by these two nervous systems. This performance indicates a thorough comprehension of the subject matter and reflects the candidates' dedication to acquiring in-depth knowledge.
Description of Better Responses	Better responses encompassed a comprehensive understanding of autonomic nervous system effects. Candidates wisely detailed the sympathetic responses in the liver, cardiac muscles, pancreas, and adrenal medulla, linking each to energy mobilisation and stress response. Additionally, their articulation of the parasympathetic system's role post-rescue, restoring normal functions through glycogen synthesis, bile secretion, cardiac muscle relaxation, and digestive enzyme/insulin secretion, exemplified a deep grasp of autonomic balance. These responses adeptly captured the intricate regulation of physiological processes, showcasing exceptional comprehension of the topic.

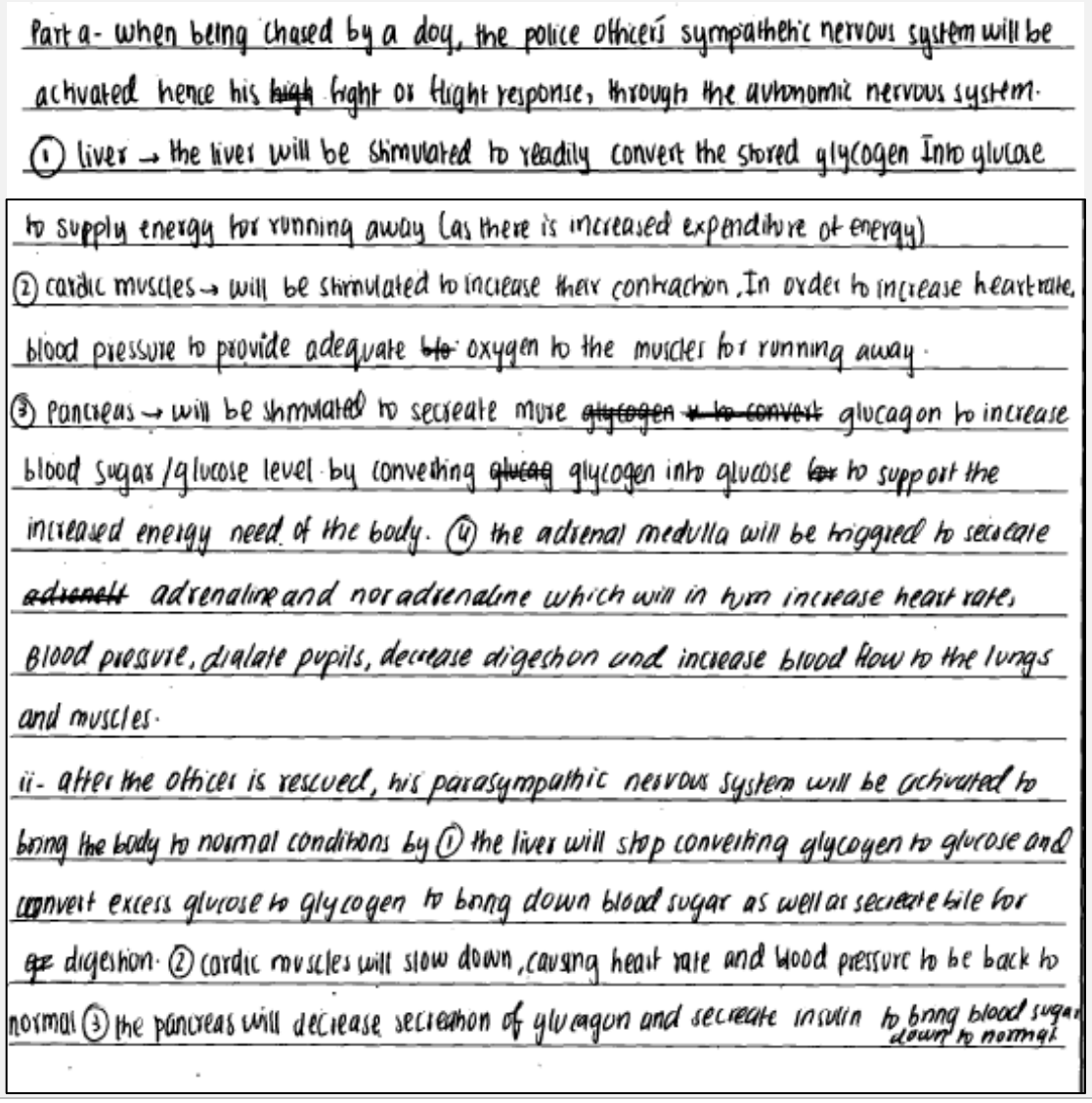
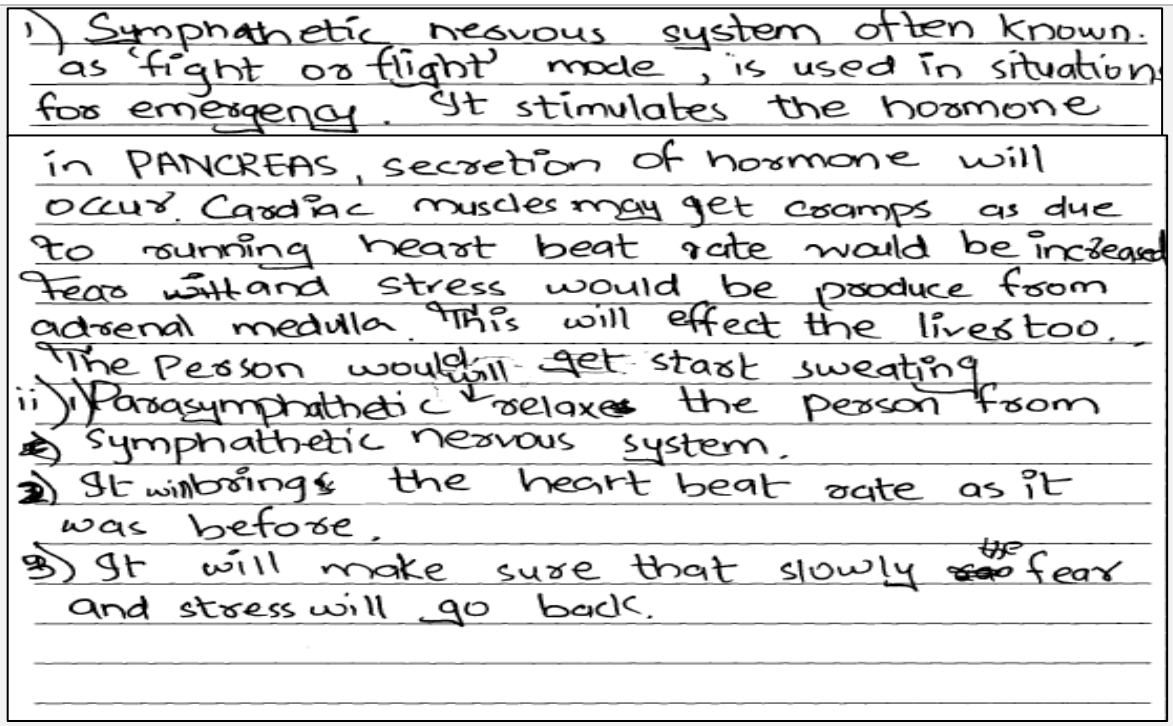
Image of Better Response	 Part a- when being chased by a dog, the police officer's sympathetic nervous system will be activated hence his ~~high~~ fight or flight response, through the autonomic nervous system. (1) liver → the liver will be stimulated to readily convert the stored glycogen into glucose to supply energy for running away (as there is increased expenditure of energy) (2) cardic muscles → will be stimulated to increase their contraction. In order to increase heartrate, blood pressure to provide adequate ~~blo~~ oxygen to the muscles for running away. (3) pancreas → will be stimulated to secreate more ~~glycogen + to convert~~ glucagon to increase blood sugar/glucose level by converting ~~glucag~~ glycogen into glucose ~~for~~ to support the increased energy need of the body. (4) the adrenal medulla will be triggred to secreate ~~adrenalt~~ adrenaline and noradrenaline which will in turn increase heart rate, Blood pressure, dialate pupils, decrease digeshon and increase blood flow to the lungs and muscles. ii- after the officer is rescued, his parasympathic nesvous system will be activated to bring the body to normal conditions by (1) the liver will stop converting glycogen to glucose and convert excess glucose to glycogen to bring down blood sugar as well as secreate bile for ~~ge~~ digestion. (2) cardic muscles will slow down, causing heart rate and blood pressure to be back to normal (3) the pancreas will decrease secreation of glucagon and secreate insulin to bring blood sugar down to normal
Description of Weaker Responses	Weaker responses exhibited a limited understanding of the sympathetic and parasympathetic nervous systems. These responses often included irrelevant functions of effectors, indicating a lack of comprehension. Moreover, candidates struggled to differentiate between the distinct effects produced by these two systems. To improve, candidates should focus on developing a comprehensive understanding of the sympathetic and parasympathetic divisions, their respective functions, and the specific physiological responses they elicit. Strengthening knowledge in these areas will enhance the ability to provide accurate and differentiated explanations of the effects produced by these two nervous systems.

Image of Weaker Response	

i) Symphathetic nervous system often known as 'fight or flight' mode, is used in situations for emergency. It stimulates the hormone in PANCREAS, secretion of hormone will occur. Cardiac muscles may get cramps as due to running heart beat rate would be increased fear with and stress would be produce from adrenal medulla. This will effect the liver too. The person would will get start sweating

ii) i) Parasymphathetic relaxes the person from
2) Symphathetic nervous system.
2) It will bring the heart beat rate as it was before.
3) It will make sure that slowly ~~the~~ fear and stress will go back.

Suggestions for Improvement (Highlighted part)

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Any Additional Suggestion:
Teachers are advised to connect the concepts to real-life examples and applications. This helps students see the relevance and practical implications of effects of sympathetic and parasympathetic nervous systems.

Question No. 11b	
Question Text	A 28-year-old female delivered a baby boy. On examination, the newborn was slow in crying and suffered from jaundice and haemolytic anaemia. The following box shows the history of the patient. **History of the Patient** • Mother is Rh^- and the father is Rh^+ • Second pregnancy • Rhogam (Rh antibodies) was NOT administered to the mother after the first delivery i. Identify the medical condition of the child. ii. Explain the cause of the medical condition identified in part 'i' in THREE points. iii. Why would rhogam (Rh antibodies) have been beneficial if it was administered after the first delivery?
SLO No.	22.4.3
SLO Text	Discuss the role of Rh factor in erythroblastosis foetalis and its prevention in newborns.
Max Marks	7
Cognitive Level	U
Checking Hints	i. 1 mark for identifying the medical condition of the child ii. 1 mark for each point of explanation (any THREE required) iii. 1 mark for stating the presence of Rh^- antibodies in the Rh antiserum/ Rhogam 1 mark for writing that these antibodies (present in Rhogam) would have destroyed the Rh^+ RBC of the foetus in the mother's blood 1 mark for writing that before the Rh^+ RBCs/ antigens of the foetus stimulate production of maternal anti - Rh antibodies
Overall Performance	Many of the candidates showed sound performance in this question. These candidates correctly identified the medical condition as erythroblastosis foetalis. However, some of them were not able to explain the cause of this condition comprehensively. Further, most of the responses reflected a lack of understanding about the administration of Rhogam (Rh antibodies) after the first delivery. Enhancing knowledge in these areas will lead to more comprehensive and precise explanations.
Description of Better Responses	Better responses demonstrated a precise grasp of haemolytic disease of the newborn mechanics. In part (i), candidates appropriately identified the condition and similarly in part (ii), described the immune sensitisation process involving Rh factor crossing the placenta. Their comprehensive explanation included foetal RBC-induced antibody production in the mother leading to foetal RBC lysis and anaemia. Notably, in part (iii), candidates aptly recognised Rh antibodies in Rhogam as a pre-emptive measure to prevent erythroblastosis foetalis by neutralising foetal Rh^+ antigens before maternal anti-Rh antibodies arise. These responses showcase a deep understanding of immunological complexities related to erythroblastosis foetalis mechanisms and prevention.

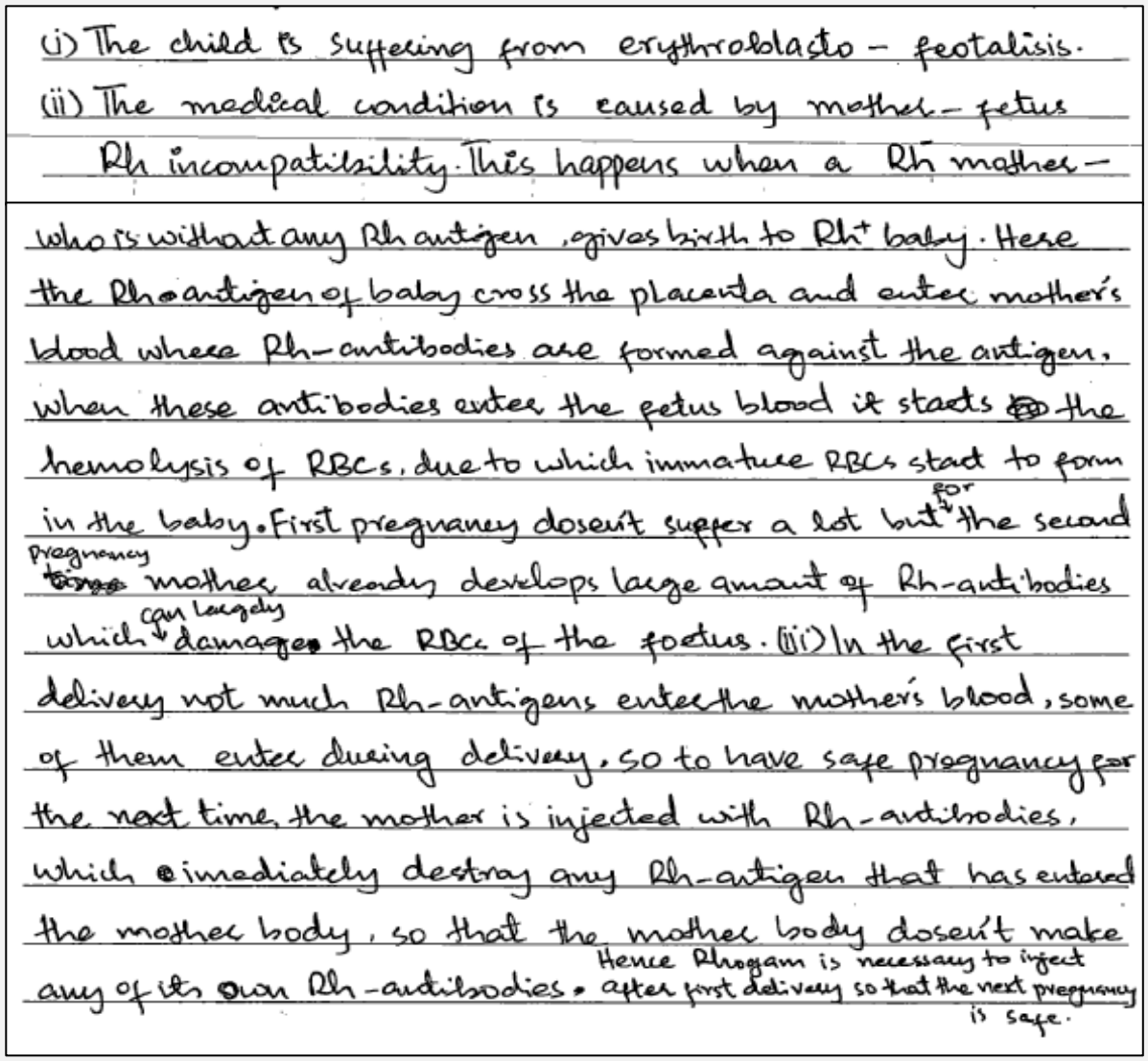
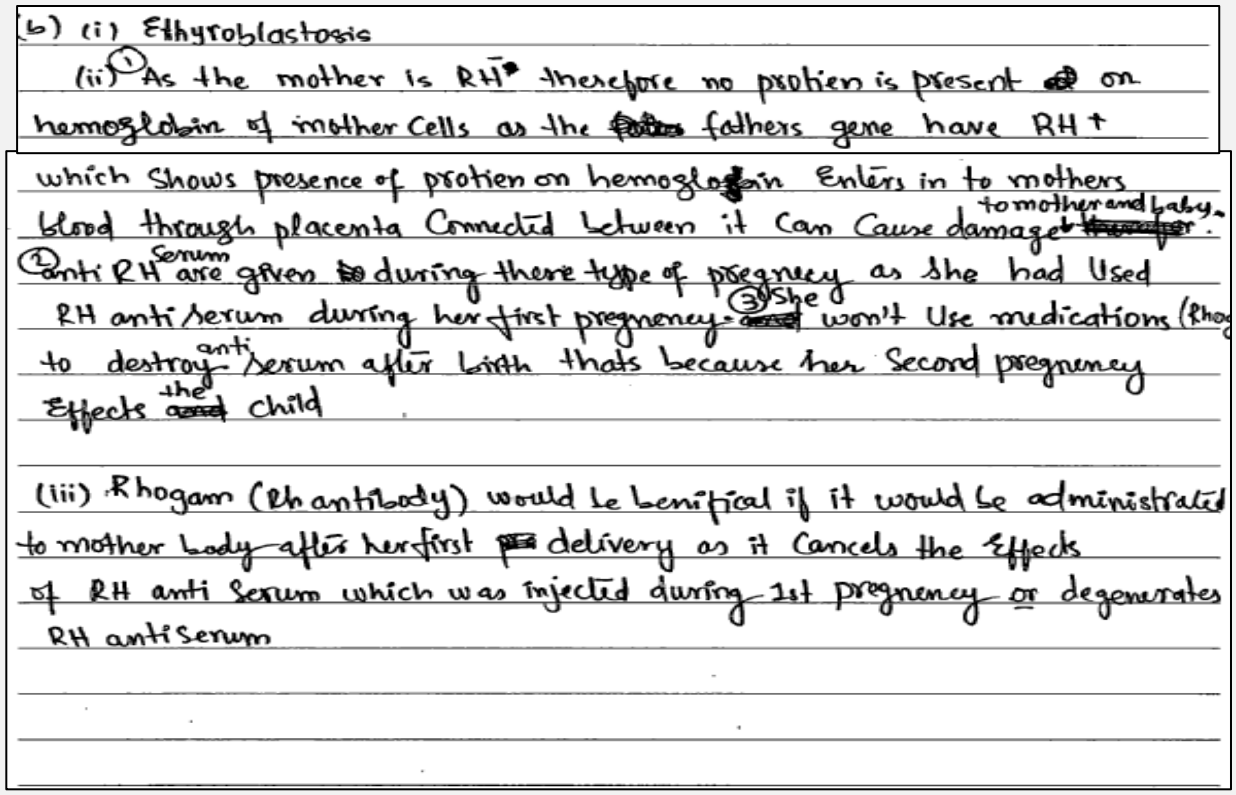
Image of Better Response	
Description of Weaker Responses	Most of the weaker responses were able to recognise the medical condition, erythroblastosis foetalis, correctly. However, a portion of the candidates struggled to provide a comprehensive explanation regarding the cause of this condition. Additionally, it appears that there was a lack of understanding among most of the candidates regarding the administration of Rhogam (Rh antibodies) after the first delivery. Candidates' responses indicated a need for further clarification and understanding in these areas.

Image of Weaker Response



(b) (i) Ethyroblastosis

(ii) (1) As the mother is RH⁻ therefore no protien is present on hemoglobin of mother cells as the fathers gene have RH+ which shows presence of protien on hemoglobin Enters in to mothers blood through placenta Connected between it Can Cause damage to mother and baby. (2) anti RH serum are given during there type of pregneey as she had Used RH anti serum during her first pregneney (3) She won't Use medications to destroy anti serum after birth thats because her Second pregneney Effects the child

(iii) Rhogam (Rh antibody) would be benifical if it would be administrated to mother body after her first delivery as it Cancels the Effects of RH anti Serum which was injected during 1st pregneney or degenerates RH antiserum

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 may use formative assessments, such as quizzes, concept mapping exercises, or journal reflections, to gauge student understanding throughout the course. These assessments provide feedback and allow for timely interventions to address misconceptions or gaps in 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.)

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