AGA KHAN UNIVERSITY EXAMINATION BOARD

Notes from E-Marking Centre SSC-I General Mathematics Annual Examinations 2023

Introduction

This document has been prepared for the teachers and candidates of Secondary School Certificate (SSC) Part I (Class IX) General Mathematics. It contains comments on candidates' responses to the 2023 SSC-I Examination indicating the quality of the responses and highlighting their relative strengths and weaknesses.

E-Marking Notes

This includes overall comments on candidates' performance on every question and *some* specific examples of candidates' responses 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 performed really well in some concepts, such as, Sets, Inheritance and Logarithm. However, candidates who did not score well mostly failed to understand the demands of the questions, often misinterpreting the command words and the stimuli.

Mentioned below are few concepts that teachers need to focus so that the candidates may perform better.

- Direct and Inverse Variations
- Business Partnership
- Algebraic Identities
- Factorisations
- Linear Graphs
- Practical Geometry

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

DETAILED COMMENTS
Constructed Response Questions (CRQs)

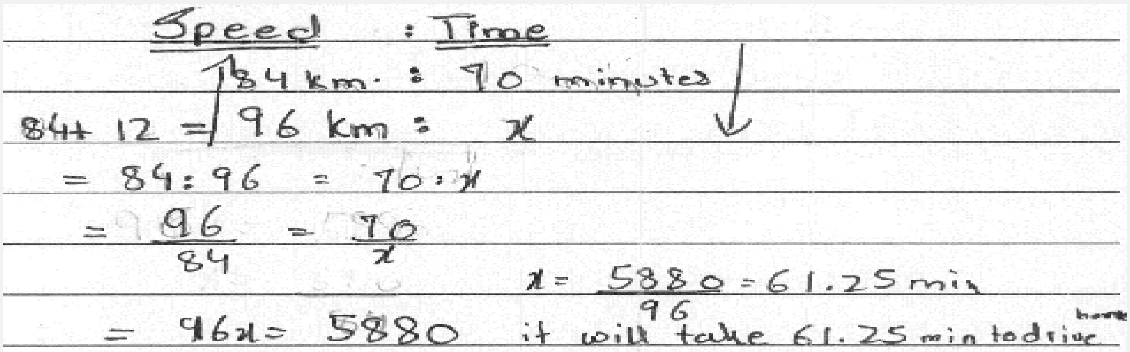
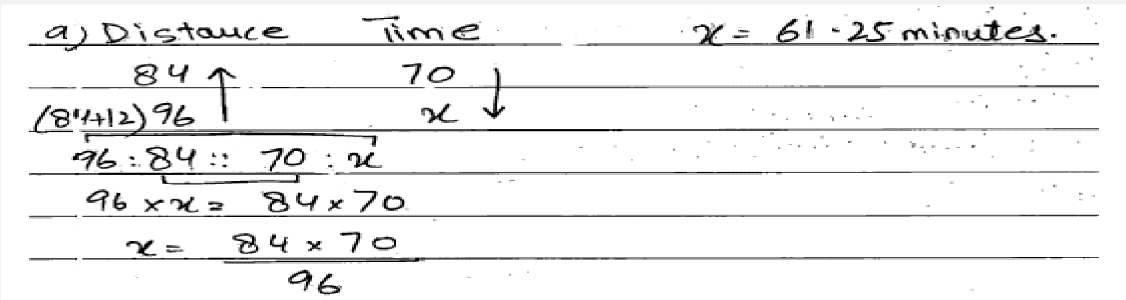
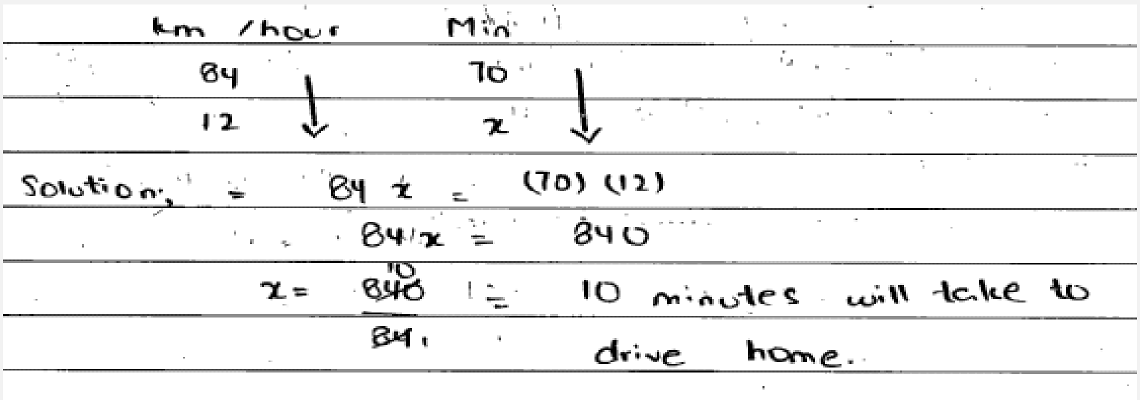
Question No. 1a Candidates were given the choice to attempt any ONE out of the two questions: 1a and 1b.	
Question Text	Atif travels from his workplace to his residence driving at 84 km/ hour in 70 minutes. If he drives 12 km/ hour faster, then calculate the time he will take to drive home.
SLO No.	1.4.3
SLO Text	Solve problems involving direct, inverse, compound proportion and variation (*x* varies directly or inversely as *y*).
Max Marks	3
Cognitive Level	A*
Checking Hints	1 mark for choosing correct values. 1 mark for using inverse proportion. 1 mark for solution (mark would be granted even if $x = \frac{70 \times 96}{84}$)
Overall Performance	The question tested the ratio and proportion. The common mistakes indicated that several candidates struggled with distinguishing between direct and inverse proportion and solving equations. A minority of candidates accurately recognised and applied inverse proportion with the given quantities.
Description of Better Responses	The better responses exhibited the clear understanding and application of difference between direct and inverse proportions. These responses adeptly incorporated the addition of 12 and 84 before employing the inverse proportion to accurately calculate the time. Hence, the candidates awarded full marks to meet the demand of the question.
Images of Better Responses	**Image (i)**  Speed : Time 84 km : 70 minutes 84+ 12 = 96 km : x = 84 : 96 = 70 : x = $\frac{96}{84}$ = $\frac{70}{x}$ $x = \frac{5880}{96}$ = 61.25 min = 96x = 5880 it will take 61.25 min to drive home **Image (ii)**  a) Distance Time x = 61·25 minutes. 84 70 (84+12) 96 x 96 : 84 :: 70 : x 96 × x = 84 × 70 $x = \frac{84 \times 70}{96}$
Description of Weaker Responses	In weaker responses, the candidates mostly neglected the expression "12 km/hour faster" and were unable to include 84 km/ hour in their calculation for 96 km/ hour. Consequently, many of them computed the time for 12 km/ hour instead of determining the time for 96 km/ hour.

Image of Weaker Response	 km /hour Min 84 70 12 x Solution, : 84 x = (70) (12) ∴ 84/x = 840 x = 840/84 (10) ∴ 10 minutes will take to drive home.

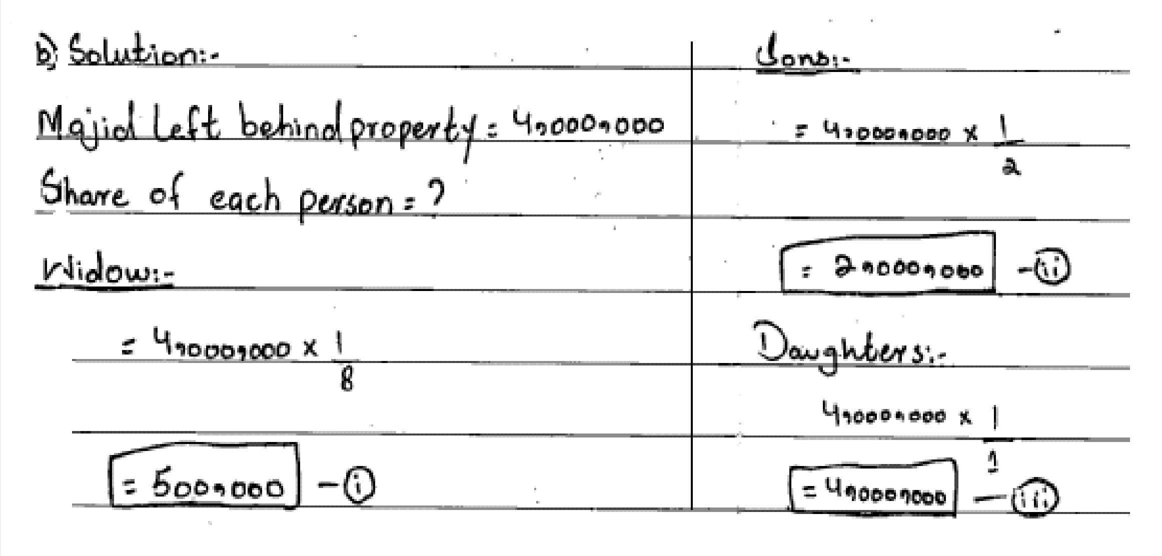
Suggestions for Improvement (Highlighted part)

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	• Story Board • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual resources • Think, Pair and Share • Questioning Technique (Socratic approach) • Practical Demonstration ** For description of each pedagogy, refer to Annexure A	• Past paper questions • Discussion on E-Marking Notes • AKU-EB Digital Learning Solution powered by Knowledge Platform https://akueb.knowledgeplatform.com/login
Any Additional Suggestion: To help with the misunderstandings seen in responses, consider offering extra learning materials that highlight the special features of different proportional and variational situations. Show clear examples and real-life cases to explain direct, inverse, and compound proportion. Also, focus on explaining the differences between direct and inverse variations in everyday situations to clear up confusion and improve performance.		

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

Question No. 1b Candidates were given the choice to attempt any ONE out of the two questions: 1a and 1b.	
Question Text	Majid left behind a property of worth Rs 4,000,000. His decedents include a son, a daughter and his widow. Calculate the share of each. (Note: Share of widow is one eighth of the property.)
SLO No.	2.3.2
SLO Text	Solve word problems based on inheritance.
Max Marks	3
Cognitive Level	A
Checking Hints	1 mark for finding widow's share. 1 mark for using finding remaining. 1 mark for son's and daughter's share from the remaining (no deduction of marks if candidate finds either daughter's or son's share)
Overall Performance	This question was related to the topic of inheritance and distribution between widow, son and daughter. Majority of the candidates attempted this question correctly and obtained full marks. Some of the candidates overlooked the phrase 'remaining' after allocating the due share to the widow, which caused the deduction in their marks.
Description of Better Responses	In better responses, the candidates successfully meet all the given requirements of the question and clearly performed each step. Such responses also demonstrated their skill in finding the remaining amount of the property, which is crucial for accurately determining the shares of both the son and daughter.
Image of Better Response	Share of Widow: $4\,000\,000 \times \frac{1}{8} = \boxed{500\,000}$ Amount Left = 4 000 000 − 500 000 = 3 500 000 Ratio of Share of son to daughter = 2 : 1 (2+1=3) Share of Son = $3\,500\,000 \times \frac{2}{3} = \boxed{2\,333\,333.3}$ Share of Daughter = $3500\,000 \times \frac{1}{3} = \boxed{1\,166\,666.6}$
Description of Weaker Responses	Weaker responses exhibited inaccuracies in calculating the shares allocated to the son and daughter. Particularly, few of the candidates did not determine the remaining amount after calculating the widow's share, leading to incorrect computations for the shares of the son and daughter from the total property value of 400,000. Additionally, some candidates computed the shares of the son and daughter based on the widow's share.
Images of Weaker Responses	**Image (i)** Data :- Property worth = 4000000 Solution :- Share of widow = $4000000 \times \frac{1}{8}$ widow share = 500000 Ratio of daughter and son = 2:1 Sum of ratio = 3 Share of son = 500000 × 2/3 son share = 333333.3 share of daughter = 500000 × 1/3 share of daughter = 166666.6

Image (ii)


b) Solution:-

Majid Left behind property = 4,000,000

Share of each person = ?

Widow:-

$= 4{,}000{,}000 \times \frac{1}{8}$

$\boxed{= 500{,}000}$ —(i)

Sons:-

$= 4{,}000{,}000 \times \frac{1}{2}$

$\boxed{= 2{,}000{,}000}$ —(ii)

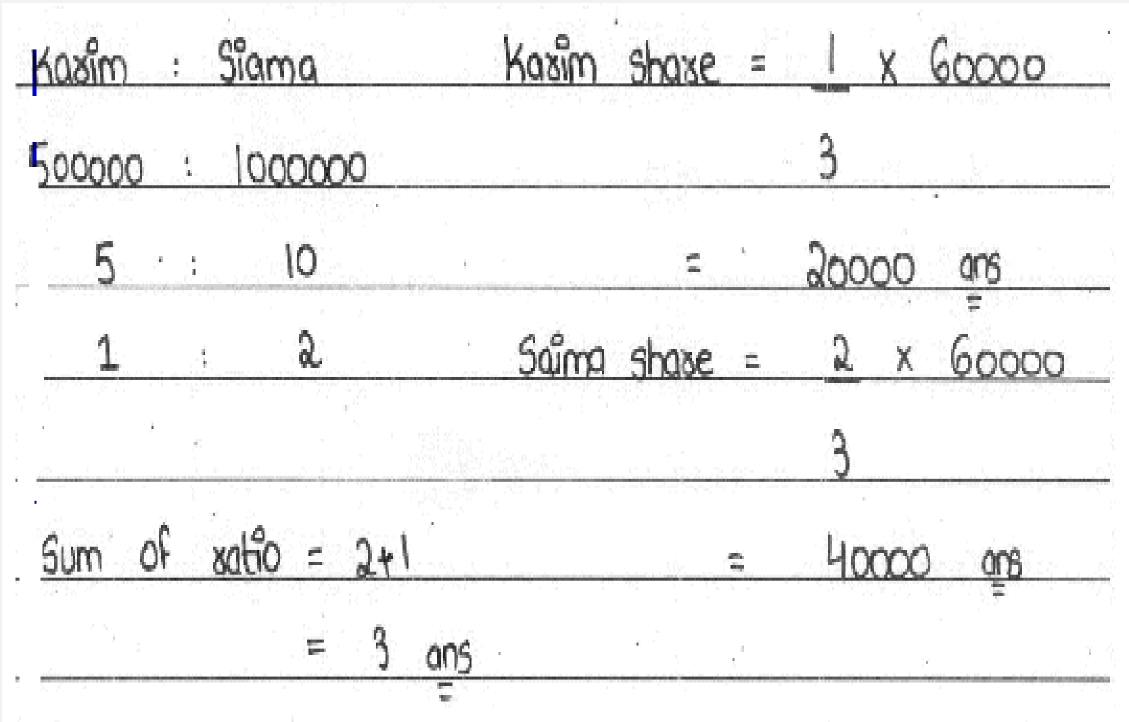
Daughters:-

$4{,}000{,}000 \times \frac{1}{1}$

$\boxed{= 4{,}000{,}000}$ —(iii)

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	• Story Board • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual resources • Think, Pair and Share • 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:		

Question No. 2	
Question Text	In a business, Karim and Saima invested Rs 500,000 and Rs 1000,000 respectively. In the first year of their business, they earned a net profit of Rs 60,000. According to the shared capital, calculate their due shares in the profit.
SLO No.	3.3.2
SLO Text	Solve word problems based on business partnership (at most four partners).
Max Marks	4
Cognitive Level	A
Checking Hints	1 mark taking ratio of their investments 1 mark for taking sum of ratio. 1 mark for calculating Karim's share. 1 mark for calculating Saima's share.
Overall Performance	This question was related to business partnership and division of profit in the ratio of the partners' investments. In this question, candidates performed well. However, some candidates reflected confusion in taking ratios, i.e., they took ratio of the invested amount and the profit. Consequently, they lost their marks.
Description of Better Responses	The better responses demonstrated a systematic approach by first determining the ratio of investments with precision. They effectively distributed the amount of profit, Rs 60,000, in accordance with the established ratio. This methodical approach ensured an accurate allocation of the profit based on the respective proportions of investments.
Image of Better Response	 Karim : Siama 500000 : 1000000 5 : 10 1 : 2 Sum of ratio = 2+1 = 3 ans Karim share = $\frac{1}{3} \times 60000$ = 20000 ans Saima share = $\frac{2}{3} \times 60000$ = 40000 ans
Description of Weaker Responses	In weaker responses, there were instances of inaccuracies in both simplifying and distributing investment ratios. Specifically, there were cases where candidates misinterpreted ratios like 5:1 and 5:10, and subsequently misapplied these ratios to the profit distribution process. Furthermore, another many of the candidates multiplied one share only by the total profit amount.

Images of Weaker Responses	**Image (i)** Net Profit = 60,000 Rs Ratio = 5:1 = 6 Karim = 60,000 × $\frac{5}{6}$ = 50,000 Rs Saima = 60,000 × $\frac{1}{6}$ = 10,000 Rs Karim's share = 50,000 Rs, Saima's share = 10,000 Rs **Image (ii)** 500'000 : 1000'000 500 : 1000 50 : 100 25 : 50 5 : 10 ~~10~~ 2 = 2 now the profit earned for the year 60'000 with respect to ratios 5 : 10 60'000 × 5 = 300'000 60'000 × 10 = 600'000

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

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	• Questioning Technique (Socratic approach) • Practical Demonstration	
Any Additional Suggestion: To address misconceptions and factors contributing weaker performance of candidates, teachers can implement the following strategy: Teach a systematic problem-solving approach. Encourage students to first simplify ratios accurately, then use them appropriately in profit distribution calculations. Offer a variety of problems involving different partnership setups and profit-sharing scenarios. Practicing with diverse cases can reinforce proper ratio handling.		

Question No. 3	
Question Text	For sets $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$, $A = \{1, 2, 3, 4, 5, 6\}$ and $B = \{2, 4, 6, 8, 10\}$, show that $(A \cup B)' = A' \cap B'$
SLO No.	4.1.3
SLO Text	Apply the following operations on sets a) union, b) intersection c) difference and d) compliment.
Max Marks	3
Cognitive Level	A
Checking Hints	1 mark for finding compliments (A^c and B^c) CORRECTLY (mark can be granted for either) 1 mark for finding $A' \cap B'$ (depends on previous working) 1 mark for finding $A \cup B$ CORRECTLY
Overall Performance	This question was related to operations on sets such as union, intersection and compliment. Candidates were required to correctly find the various components and verify the given statement. More than half of the candidates attempted this question correctly and obtained full marks. However, there were certain errors in union, intersection or compliments that led to difficulty in completing the required verification.
Description of Better Responses	Better responses diligently followed all the required steps and presented their working, as illustrated in the examples. They also clearly indicate the calculations performed on both the left-hand side (LHS) and right-hand side (RHS) of the equation, ensuring the verification of the final result as mandated by the question.

<table>
<tr>
<td>Images of Better Responses</td>
<td>

Image (i)

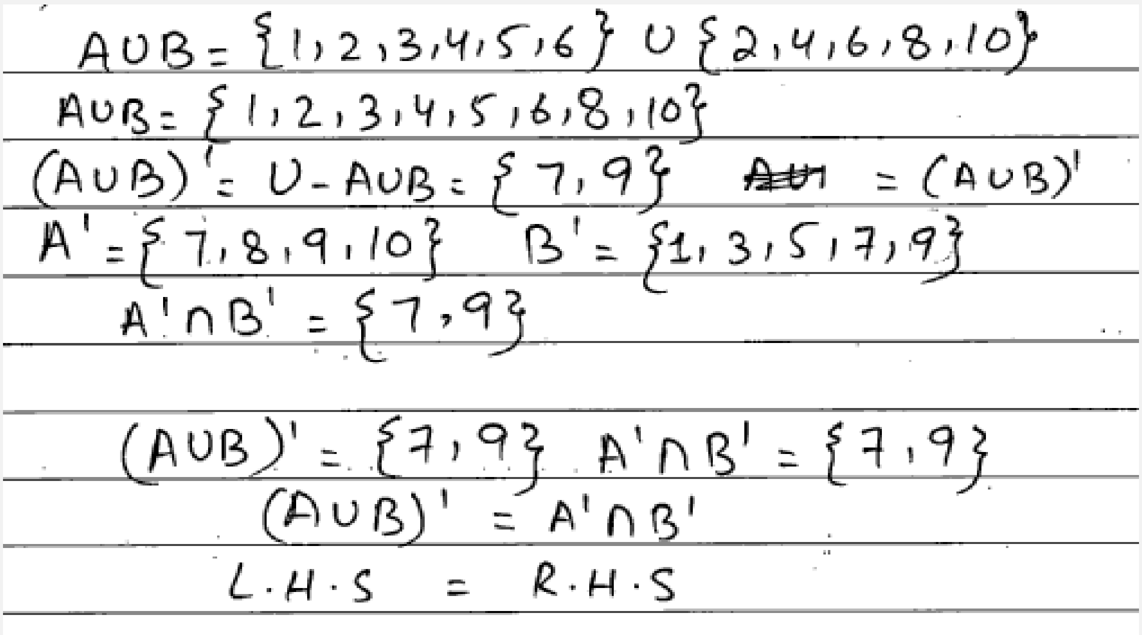
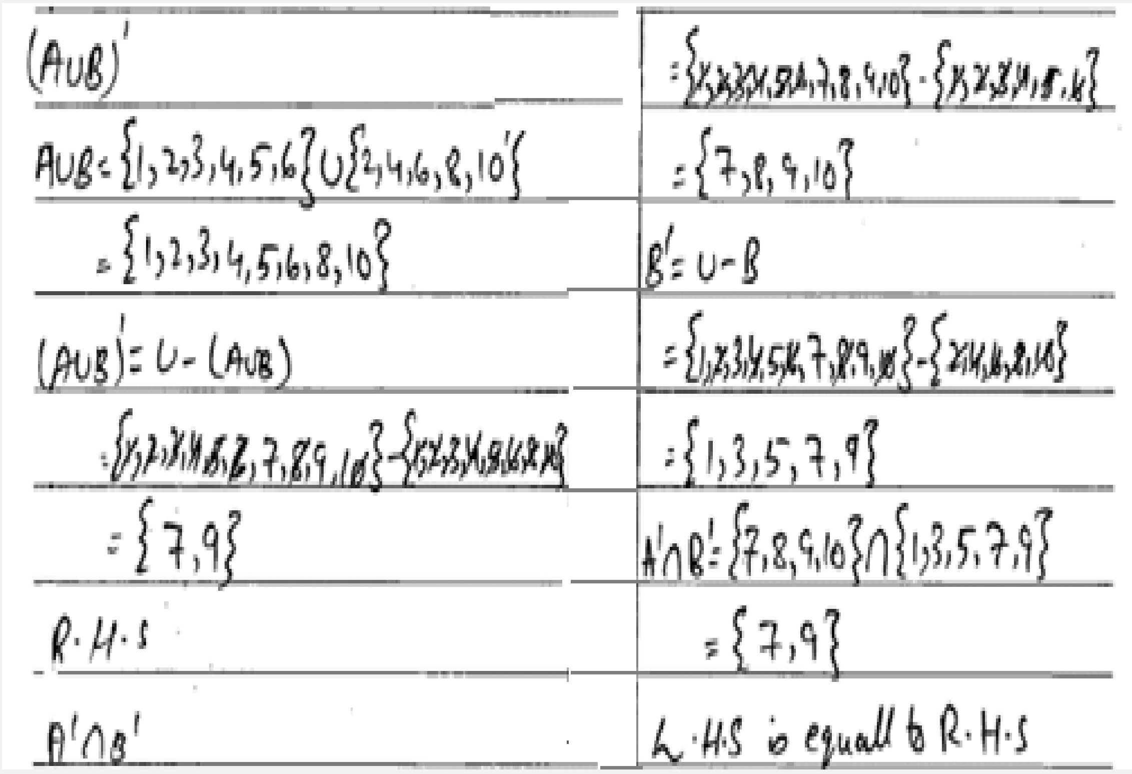


Image (ii)



</td>
</tr>
<tr>
<td>Description of Weaker Responses</td>
<td>Weaker responses struggled to understand the expression (AUB) due to unclear concepts. They tended to prioritise the determination of (AUB) while overlooking the complementing of the set (AUB)'.</td>
</tr>
</table>

Images of Weaker Responses

Image (i)

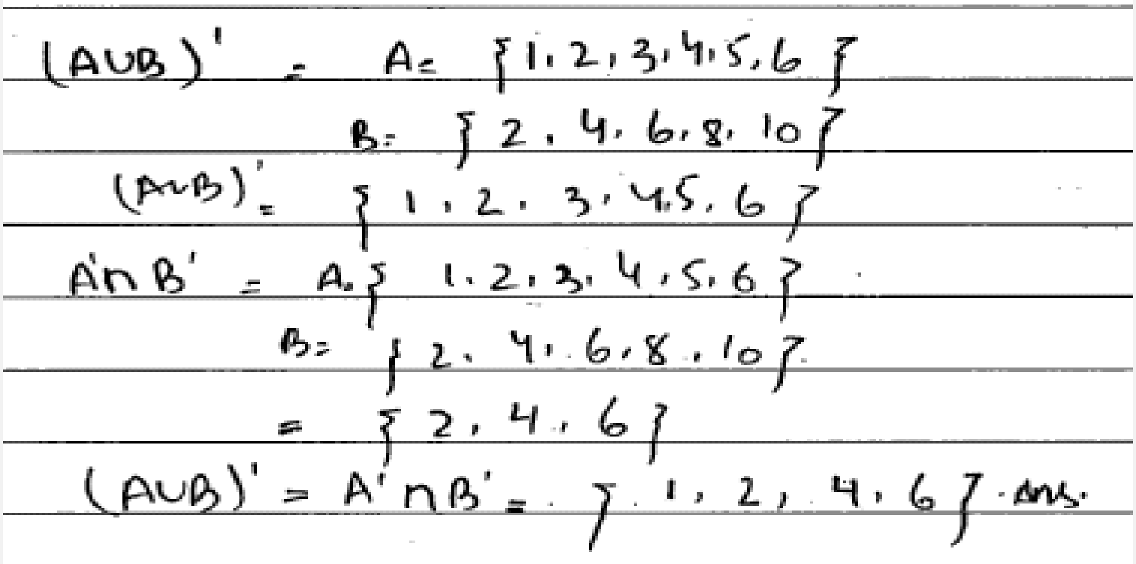
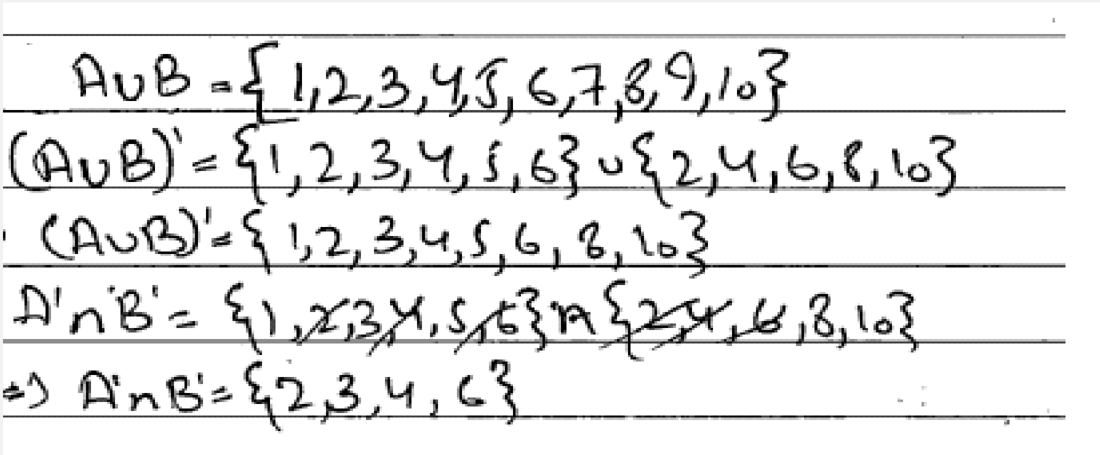


Image (ii)



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)	• Story Board • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual resources • Think, Pair and Share • 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

• Go through the past paper questions on that particular concept • Refer to the resource guide for extra resources		

Any Additional Suggestion:
To enhance better understanding of the concept, teachers are recommended to use the following strategies.
Emphasise the similarities and differences between intersections, unions, and complements.
Provide guided worksheets where students are asked to perform specific set operations. Gradually increase the complexity of operations.
Show examples of common mistakes made when representing set operations. Discuss why these mistakes occur and how to avoid them.

Question No. 4	
Question Text	Find the value of x in the equation $\log_5 625 = x$
SLO No.	5.5.1
SLO Text	Apply the following laws of logarithm to solve related problems (without using log and antilog tables).
Max Marks	3
Cognitive Level	A
Checking Hints	1 mark for writing the log $\log_5 625 = x$ as $5^x = 625$ 1 mark for expressing as $5^x = 5^4$ 1 mark for solution/ value of x
Overall Performance	This question was related to the application of one of the laws of logarithm which involved the conversion of logarithmic form to exponential form and evaluation of x. Nearly half of the candidates scored full marks whereas the others committed common errors. The errors were mostly observed in conversion of logarithmic form into exponential. Moreover, some candidates did not eliminate the logarithmic operation even after converting to the exponential form. Hence, such candidates were not able to evaluate the value of 'x'.
Description of Better Responses	Better responses exhibited a systematic approach by first transforming the logarithmic equation into exponential form and subsequently converting 625 into its equivalent form i.e., 5^4. By equating 5^x to 5^4, candidates correctly derived the value of 'x'. These answers obtained full marks due to the comprehensive presentation of each step in the solution process. Better responses also showed another method for solution of the same question. The candidates did not convert the logarithmic form to exponential. They used the law of power of logarithms after converting 625 to 5^4. In Addition, the candidates applied the concept that the logarithm of any number at its base is equal to 1. By incorporating these principles into their solution, the candidates showcased a strong understanding of the topic and successfully derived the correct solution. As a result, such candidates scored full marks for their adept application of these techniques.

Image of Better Response	$\log_5 625 = x$ $5 \downarrow a$, $625 \downarrow y$, $\downarrow x$ $\Rightarrow y = a^x \rightarrow$ Exponential form $\Rightarrow y = a^x,\ 625 = 5^x$ $\Rightarrow (25)^2 = 5^x$ $\Rightarrow (5)^4 = 5^x$ $\Rightarrow$ bases are same. $\Rightarrow x = 4 \rightarrow$ value of x is 4 (Ans.)
Description of Weaker Responses	In weaker responses, errors were mostly noted during the conversion of logarithmic forms into exponential forms. While many candidates managed the initial conversion, they faced challenges in simplifying equations afterward. A common mistake involved division of 625 by 5 in the process of further simplification.
Image of Weaker Response	$\log_5 625 = x$. using exponential form to find x. $y = a^x$ $625 = 5^x$ $\dfrac{\cancel{625}^{125}}{\cancel{5}_1} = x$. $\boxed{125 = x}$ The value of x is 125.

Suggestions for Improvement (Highlighted part)

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Any Additional Suggestion: While teaching the concept of application of the law of logarithm, teachers are advised to use the following strategies: Clear Explanation of Laws**:** Begin by providing a clear and concise explanation of each logarithmic law, along with examples illustrating their correct application. Emphasis when and why each law is used. Error Analysis Activities**:** Provide students with incorrect solutions and ask them to identify and explain the errors. Discuss the common misconceptions that might have led to those errors and guide students in correcting the solutions.		

Question No. 5	
Question Text	It is given that $(2a+1)=6$ and $(2a-1)=4$ Using appropriate algebraic formula, find the value of i. $4a^2-1$ ii. $4a^2+1$
SLO No.	6.2.1
SLO Text	Find the value of $(a+b)$, $(a-b)$, a^2-b^2, a^2-b^2 and ab using the formulae *a &c.*
Max Marks	4
Cognitive Level	A
Checking Hints	i. 1 mark writing in the form $4a^2-1=(2a+1)(2a-1)$ 1 mark for writing in the form $4a^2-1=6\times4$ ii. 1 mark applying the formula as $2(4a^2+1)=(2a+1)^2+(2a-1)^2$ 1 mark for substitution of the values (mark would be granted if $2(4a^2+1)=6^2+4^2$)

Overall Performance	This question was related to the application of algebraic identities to evaluate the given expressions. The identities to be applied were already given to the candidates in the formula sheet. Only a few of the candidates were able to meet the demand of the question. The common errors included the identification of irrelevant algebraic identity and incorrect substitution of values.
Description of Better Responses	Better responses demonstrated a thorough comprehension of the given concept as they applied the correct identity and diligently followed all the necessary steps. Two of the examples are given below.
Image of Better Response	$4a^2+1=?\ ,\ (2a+1)=6\ ,\ (2a-1)=4$ $\therefore 2(a^2+b^2)=(a+b)^2+(a-b)^2$ $2(4a^2+1)=(6)^2+(4)^2$ $2(4a^2+1)=36+16$ $2(4a^2+1)=52$ $4a^2+1=\frac{\cancel{52}\,26}{2}$ $4a^2+1=26.$ $4a^2-1^2$ $(2a+1)(2a-1)$ $(6)(4)$ 24 Ans
Description of Weaker Responses	In part (i), a common error was identified where candidates accurately recognised the relevant identity, however, they were unable to comprehensively substitute the provided values, resulting in incomplete solutions. In part (ii), many of the candidates faced challenges in effectively applying the appropriate algebraic identity, it was observed that certain candidates associated the identity with factorisation, leading them to transform it into a 'completing the square' form by adding the term 4a.

Images of Weaker Responses	**Image (i)** $4a^2+1 \quad = a^2+b^2+2ab$ $(2a)^2+(1)^2+2(2a)(1)$ $(2a+1)^2$ $(2a+1)(2a+1)$ Ans **Image (ii)** $4a^2-1$ $(2a)^2-(1)^2$ $(2a-1)(2a+1)$ Ans

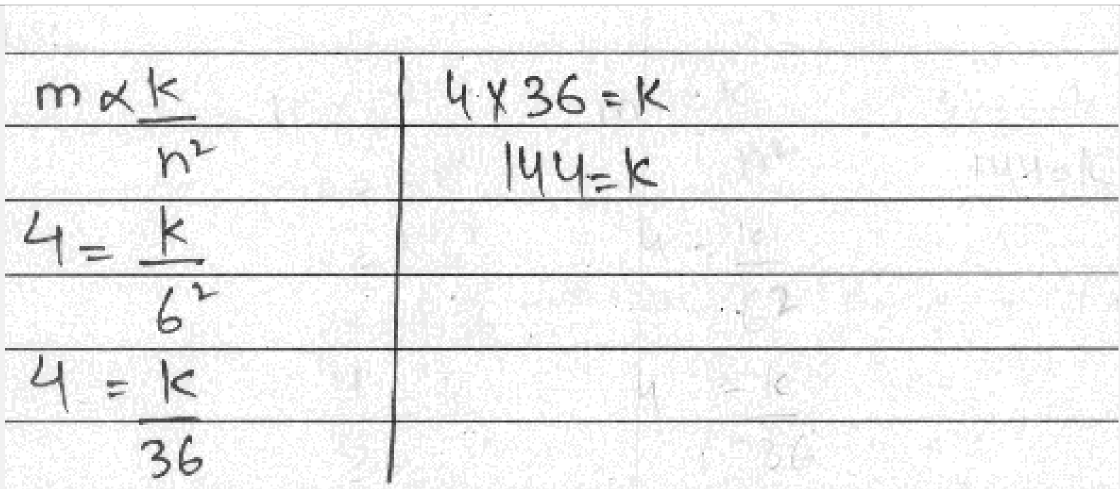
Suggestions for Improvement (Highlighted part)

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	• Story Board • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual resources • Think, Pair and Share • Questioning Technique (Socratic approach) • Practical Demonstration	• Past paper questions • Discussion on E-Marking Notes • AKU-EB Digital Learning Solution powered by Knowledge Platform https://akueb.knowledgeplatform.com/login
Any Additional Suggestion:		

To address the confusions and misconception observed in responses, it is recommended that, a significant focus should be directed towards substituting values into identities. Teachers can contribute by defining the differences between these concepts and providing students with step-by-step examples. his approach can enhance the precision of selecting the right algebraic identity. This comprehensive strategy fosters growth, aiding candidates in steering clear of misconceptions and refining their overall performance.

Question No. 6a

Candidates were given the choice to attempt any ONE out of the two questions: 6a and 6b.

Question Text	Completely factorise the polynomials $2x^2 - 14x + 20$.
SLO No.	7.1.1g
SLO Text	Factorise the expression of the following types g. $ax^2 + bx + c$.
Max Marks	4
Cognitive Level	A
Checking Hints	1 mark for taking 2 common from the expression. 1 mark for middle term break down. 1 mark for taking x and -5 common as $x(x-2)-5(x-2)$ 1 mark for writing in completely factorised form as $= 2\{(x-2)(x-5)\}$.
Overall Performance	There were certain common errors observed that caused deduction in marks. Some of them did not take 2 common, neither at the beginning nor at the end. In addition, candidates incorrectly broke he middle term. A few of the candidates attempted this part were able to and demonstrate the correct solution of the required concept. Such candidates scored full marks. Only few of the candidates attempted this part.
Description of Better Responses	The candidates responded with better responses to this question accurately took 2 common and broke the middle term as per requirement. Furthermore, they applied factorisation by grouping to get the correct common factors. However, some candidates took 2 common at the end of factorisation.
Image of Better Response	
Description of Weaker Responses	Candidates exhibiting weaker responses were unable to differentiate between the like and unlike terms and performed the operation of addition without considering the mentioned concept. Some candidates also struggled with of manipulation of algebraic terms and were not able to factorise.

Images of Weaker Responses	**Image (i)** $2x^2 - 14x + 20$ $4x - 14x + 20$ $10x^2 + 20$ $20 + 20$ 40 Ans **Image (ii)** A) $2x^2 - 14x + 20$ $= 2(x^2 - 7 + 10)$ $= 2(x + 3.5 + \cancel{5})\ (x - 3.5 + \cancel{8})$ $= (2 - 7)$ ans

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	• Story Board • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual resources • Think, Pair and Share • 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 suggested to emphasis on understanding the difference between like and unlike terms.
Offer exercises that focus on identifying and grouping these terms correctly.
Engage students in activities that involve adding terms while considering this concept, fostering accuracy in their mathematical operations.
Moreover, introduce step-by-step exercises that guide students through manipulating algebraic terms. Start with simple expressions and gradually increase complexity.
Emphasise techniques for rearranging terms and simplifying expressions, preparing them for successful factorisation tasks.

Question No. 6b
Candidates were given the choice to attempt any ONE out of the two questions: 6a and 6b.

Question Text	Write the THREE factors of the polynomial x^3+2x^2-x-2 using factor theorem.
SLO No.	7.3.1
SLO Text	Apply factor theorem to factorise a cubic polynomial.
Max Marks	4
Cognitive Level	A
Checking Hints	1 mark for applying the factor theorem. 1 mark for each factor (3 required) (Note: Marks shall be granted if candidate finds the first factor by factor theorem and the remaining three by division and further factorisation)
Overall Performance	This question assessed candidates' performance in applying the factor theorem to factorise a cubic polynomial highlighted both strengths and areas for improvement. Many of the responses revealed misconceptions, with some candidates resorting to inappropriate techniques leading to inaccuracies. Majority of the candidates attempted this part.
Description of Better Responses	Better responses exhibited the correct application of the factor theorem with correct factors identification. Such responses showed all the three factors written in product form. Moreover, some candidates were also able to find all the factors, though they applied the factor theorem.

<table>
<tr><td>Image of Better Response</td><td>

$p = 2, \pm 1, \pm 2$

$q = 1$

x^3+2x^2-x-2

$(x-1)(x+1)(x+2)$ Ans.

$a = 1$	$a = -1$	$a = -2$
$= x^3+2x^2-x-2$	$= x^3+2x^2-x-2$	$= x^3+2x^2-x-2$
$= (1)^3+2(1)^2-(1)-2$	$= (-1)+2(-1)^2-(-1)-2$	$= (-2)^3+2(-2)^2-(-2)-2$
$= 1+2-1-2$	$= -1+2+1-2$	$= -8+8+2-2$
$= 0$	$= 0$	$= 0$

</td></tr>
<tr><td>Description of Weaker Responses</td><td>The candidates exhibited misconceptions regarding the factor theorem, as they did not employ it to factorise the cubic polynomial. Instead, they attempted inappropriate methods like grouping or middle term break-up, leading to inaccurate results. Others applied the polynomial's zero to establish factors but left the response incomplete without listing all the factors.</td></tr>
<tr><td>Images of Weaker Responses</td><td>

Image (i)

$= x^3 + 2x^2 - x - 2$

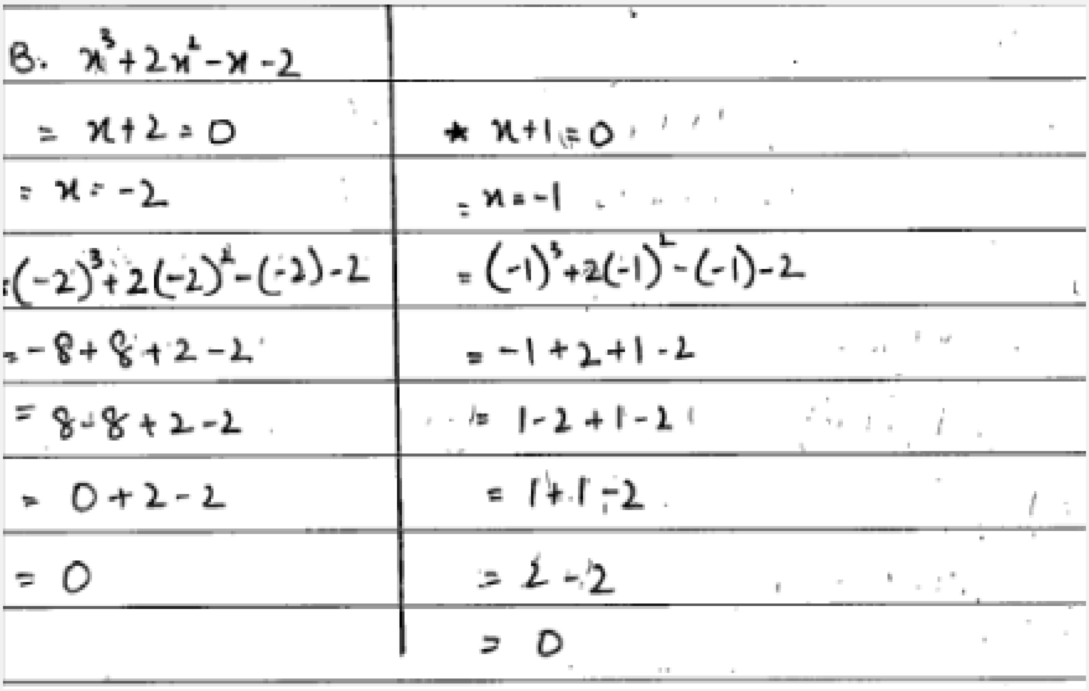
$= x^3 - x + 2x^2 - 2$

$x(x^2-1) + 2(x^2-1)$

$(x+2)(x^2-1)$

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

Image (ii)



B. x^3+2x^2-x-2	
$= x+2=0$	$* \; x+1=0$
$= x=-2$	$= x=-1$
$(-2)^3+2(-2)^2-(-2)-2$	$=(-1)^3+2(-1)^2-(-1)-2$
$=-8+8+2-2$	$=-1+2+1-2$
$= 8-8+2-2$	$= 1-2+1-2$
$= 0+2-2$	$= 1+1-2$
$= 0$	$= 2-2$
	$= 0$

Suggestions for Improvement (Highlighted part)

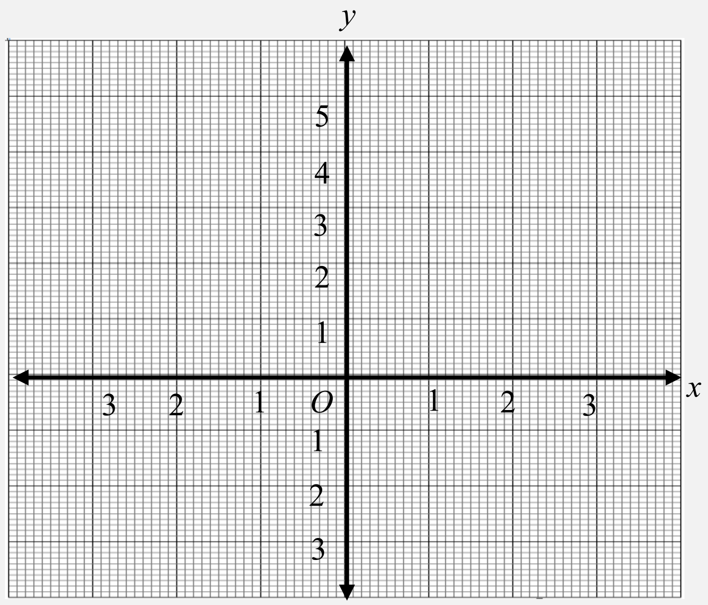
How to Approach SLO	Pedagogy Used for that SLO	Assessment Strategies
• Understand the expectations of the command words • Look at the cognitive level • Identify the content that is required to answer that question (both in terms of understanding of concepts and any skills that may be required like analysing or evaluating) • Go through the past paper questions on that particular concept • Refer to the resource guide for extra resources	• Story Board • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual resources • Think, Pair and Share • Questioning Technique (Socratic approach) • Practical Demonstration	• Past paper questions • Discussion on E-Marking Notes • AKU-EB Digital Learning Solution powered by Knowledge Platform https://akueb.knowledgeplatform.com/login
Any Additional Suggestion: To improve this concept, teachers are suggested to explain the concept clearly and provide relatable examples to illustrate its application. Break down the factorisation process into step-by-step instructions. Guide students through each step, explaining the rationale behind it. This can help them follow a structured and accurate approach. Offer a range of problems that require the factor theorem for factorisation. Provide both straightforward and complex examples to foster confidence and adaptability.		

Demonstrate worked examples that adhere to the marking scheme. Highlight the correct steps, from identifying factors to presenting them in product form. This visual guidance can clarify the expectations

<table>
<tr><th colspan="2">Question No. 7</th></tr>
<tr><td>Question Text</td><td>Using the linear equation $y = 2x + 1$,
i. complete the given table.

<table>
<tr><td>x</td><td>-2</td><td>1</td><td>0</td><td></td></tr>
<tr><td>$y = 2x + 1$</td><td></td><td>3</td><td>1</td><td>5</td></tr>
</table>

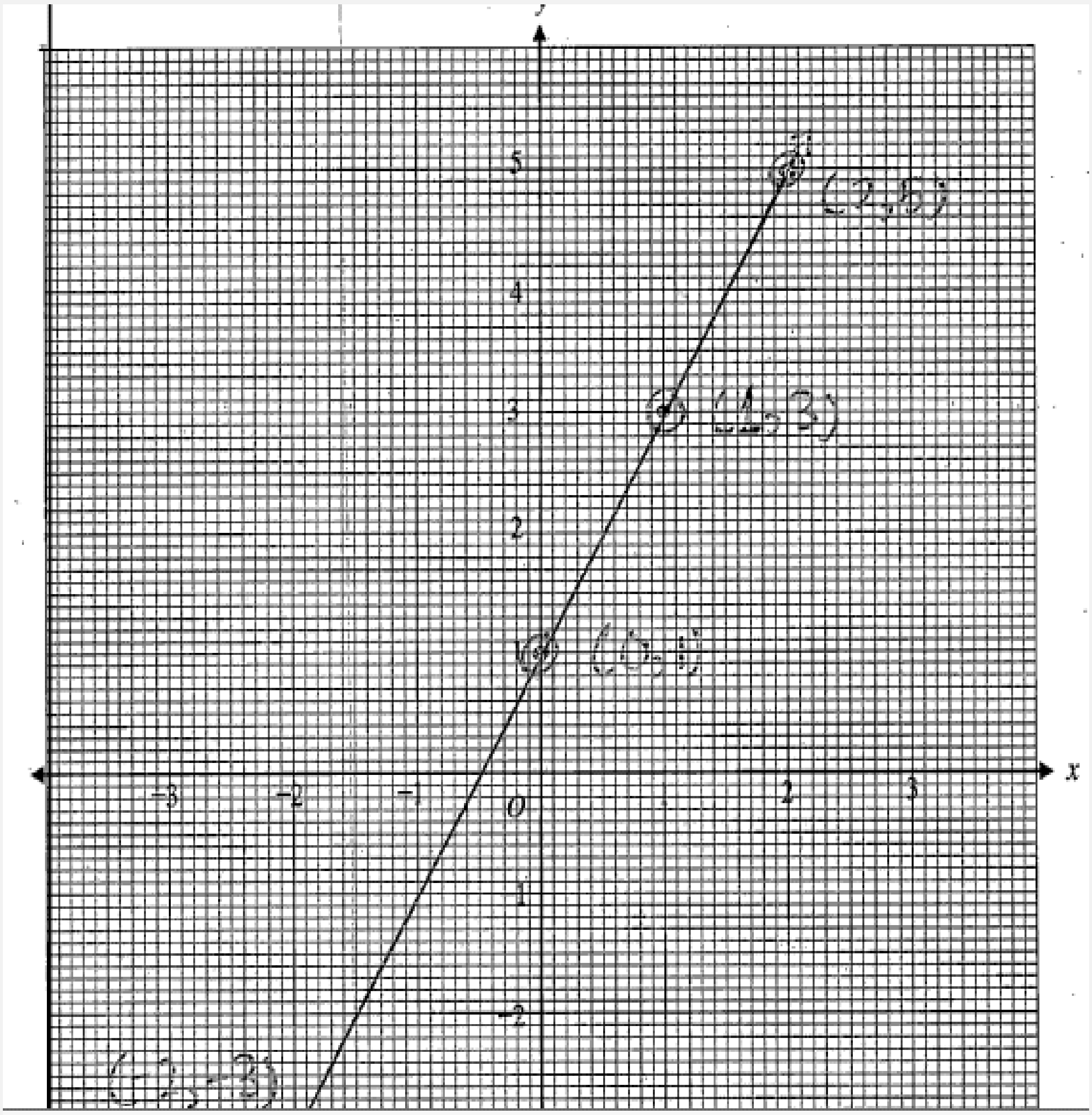
ii. hence, plot the points and draw the graph.



</td></tr>
<tr><td>SLO No.</td><td>8.1.6</td></tr>
<tr><td>SLO Text</td><td>Draw the graph of given linear equations d) $y = mx + c$.</td></tr>
<tr><td>Max Marks</td><td>3</td></tr>
<tr><td>Cognitive Level</td><td>A</td></tr>
<tr><td>Checking Hints</td><td>1 mark for correctly filling the table.
1 mark for plotting the points.
1 mark for drawing the graph joining the points</td></tr>
<tr><td>Overall Performance</td><td>This question was related to graphs of linear equation. In this question, candidates completed the table and drew its graph by connecting the plotted points. Thus, this question tested two concepts, namely, solution of a linear equation and graphical representation of a straight line. More than half of the candidates correctly attempted this question. Although a vast majority of the candidates could complete the table however, they were able to plot points on the graph correctly.</td></tr>
<tr><td>Description of Better Responses</td><td>Candidates with better responses exhibited their ability to solve linear equation and to calculate the value of x when y is given or vice versa. Moreover, better responses also reflected candidates' graph plotting skills. A scaled graph grid was provided to facilitate accurate graphing.</td></tr>
</table>

Image of Better Response

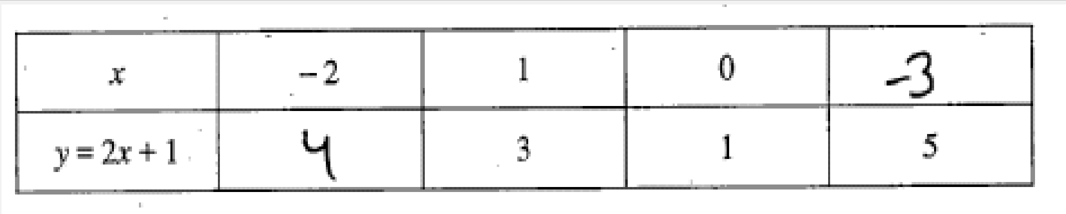
x	−2	1	0	2
$y = 2x + 1$	-3	3	1	5



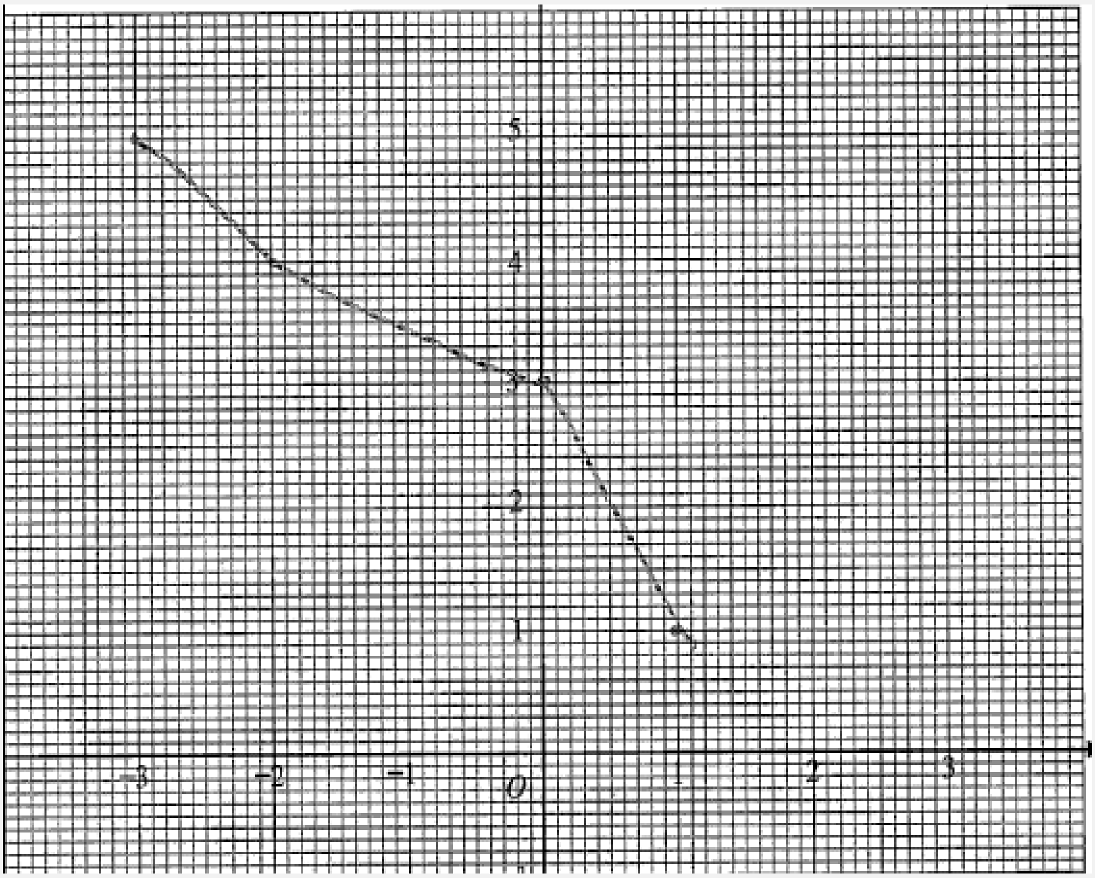
Description of Weaker Responses

Weaker responses reflected candidates' inability to find the corresponding value of the other variable when one is given for a linear equation. Moreover, weaker responses also reflected weak graphing skills. Such responses could not show a straight line graph.

Image of Weaker Response



x	-2	1	0	-3
$y = 2x + 1$	4	3	1	5



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)	• Story Board • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual resources • Think, Pair and Share • 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

• Go through the past paper questions on that particular concept • Refer to the resource guide for extra resources		

Any Additional Suggestion:
To enhance better understanding of the concept, teachers are recommended to use the following strategies.
Interactive Demonstrations: Utilise technology, interactive whiteboards, or graphing software to demonstrate how the graph changes when altering the values of m and c. Allow students to explore different scenarios and observe the effects on the graph.
Real-World Scenarios: Present real-world scenarios where linear equations are applicable, such as distance-time relationships or cost functions. Let students create equations based on these scenarios and graph them.
Guided Practice: Provide guided practice problems where students are given equations to graph. Walk them through the process, emphasising the importance of identifying the slope and y-intercept correctly.

Question No. 8a

Candidates were given the choice to attempt any ONE out of the two questions: 8a and 8b.

Question Text	For the matrix $A = \begin{bmatrix} 1 & -1 \\ 2 & 0 \end{bmatrix}$, i. find A^{-1}. ii. show that $AA^{-1} = I$.
SLO No.	9.5.7
SLO Text	Find the multiplicative inverse of a matrix A and verify that $AA^{-1} = I$, where I is the multiplicative identity matrix.
Max Marks	3
Cognitive Level	A
Checking Hints	1 mark for finding adjoint. 1 mark for finding inverse. 1 mark for multiplying A and inverse of A and getting I.
Overall Performance	This question was related to finding multiplicative inverse of a non-singular matrix. It involved essential steps such as finding adjoint, determinant and multiplication of the reciprocal of the determinant with the adjoint. A few of the candidates got full marks, by applying all the above listed steps efficiently. However, some candidates made errors in calculating determinant and adjoint; consequently, the multiplicative inverse was incorrect. Therefore, they could not complete the verification. Both parts equally attempted by the candidates. Majority of the candidates attempted this part.
Description of Better Responses	Better responses, exhibiting clarity of the concept of multiplicative inverse of non-singular matrix. Moreover, candidates giving such responses calculated the essentials such as determinant and adjoint of the given matrix. Also, candidates correctly multiplied the inverse with the matrix to verify the identity matrix.

Image of Better Response	$A^{-1} = \frac{\text{adj} A}{\lvert A \rvert}$ $A^{-1} = \frac{\begin{bmatrix} 0 & 1 \\ -2 & 1 \end{bmatrix}}{2}$ $A^{-1} = \begin{bmatrix} 0\times\frac{1}{2} & 1\times\frac{1}{2} \\ -2\times\frac{1}{2} & 1\times\frac{1}{2} \end{bmatrix}$ $A^{-1} = \begin{bmatrix} 0 & \frac{1}{2} \\ -1 & \frac{1}{2} \end{bmatrix}$ $A\cdot A^{-1} = \begin{bmatrix} 1 & -1 \\ 2 & 0 \end{bmatrix} \times \begin{bmatrix} 0 & \frac{1}{2} \\ -1 & \frac{1}{2} \end{bmatrix}$ $A\cdot A^{-1} = \begin{bmatrix} 1\times 0+(-1)\times(-1) & 1\times\frac{1}{2}+(-1)\times\frac{1}{2} \\ 2\times 0+0\times(-1) & 2\times\frac{1}{2}+0\times\frac{1}{2} \end{bmatrix}$ $A\cdot A^{-1} = \begin{bmatrix} 0+1 & \frac{1}{2}-\frac{1}{2} \\ 0+0 & 1+0 \end{bmatrix}$ $A\cdot A^{-1} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ $= I$ verified
Description of Weaker Responses	Weaker response, a notable confusion between multiplicative inverse (A^{-1}) and additive inverse was evident. Furthermore, candidates struggled with misconceptions while calculating the adjoint and determinant, as well as recognizing the identity matrix. The complexities of matrix multiplication also posed difficulties for some candidates, further contributing to the observed struggles in this area.
Image of Weaker Response	$A = \begin{bmatrix} 1 & -1 \\ 2 & 0 \end{bmatrix}$ $A^{-1} = \begin{bmatrix} -1 & 2 \\ -1 & -0 \end{bmatrix}$ $A = (-1 \times -0) - (-1 \times 2)$ $A = 0 - 2$ $A = -2$ Ans $A^{-1} = \frac{1}{\lvert A \rvert} = \text{Adj } A$ $-2 = \frac{1}{-2}$ $AA^{-1} = I$ $A = \begin{bmatrix} 1 & -1 \\ 2 & 0 \end{bmatrix} + A^{-1} \begin{bmatrix} -1 & 2 \\ -1 & 0 \end{bmatrix}$ $AA^{-1} = \begin{bmatrix} +1-1 & -1+2 \\ +2-1 & 0-0 \end{bmatrix}$ $AA^{-1} = \begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix} = I$ Proved

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	• Story Board • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual resources • Think, Pair and Share • Questioning Technique (Socratic approach) • Practical Demonstration	• Past paper questions • Discussion on E-Marking Notes • AKU-EB Digital Learning Solution powered by Knowledge Platform https://akueb.knowledgeplatform.com/login
Any Additional Suggestion: To address misconceptions and factors contributing weaker performance of candidates, teachers can implement the following strategy: Begin with simple matrix equations and provide step-by-step examples. Demonstrate how to isolate the variable matrix by applying matrix operations like addition, subtraction, multiplication, and inversion. Teach the concept of the inverse matrix and how it can be used to solve matrix equations. Emphasize that not all matrices have inverses and discuss conditions for inevitability. Use matrix-solving software or calculators to demonstrate solutions to matrix equations. Encourage students to use these tools for practice and verification i.e., mathstools and Symbolab.		

Question No. 8b Candidates were given the choice to attempt any ONE out of the two questions: 8a and 8b.	
Question Text	Solve the given matrix equation to find the matrix X. $X + 2\begin{bmatrix} 1 & -1 \\ 1 & 0 \end{bmatrix}\begin{bmatrix} 3 \\ 2 \end{bmatrix} = \begin{bmatrix} -1 \\ 1 \end{bmatrix}$
SLO No.	9.6.1
SLO Text	Solve matrix equations.
Max Marks	3
Cognitive Level	A
Checking Hints	1 mark multiplying by 2. 1 mark for mark for multiplying the matrices on LHS. 1 mark for subtracting on the RHS.
Overall Performance	This question was related to solving matrix equations. It involved essential steps such as scalar multiplication, matrix multiplication and matrix subtraction. Some of the candidates

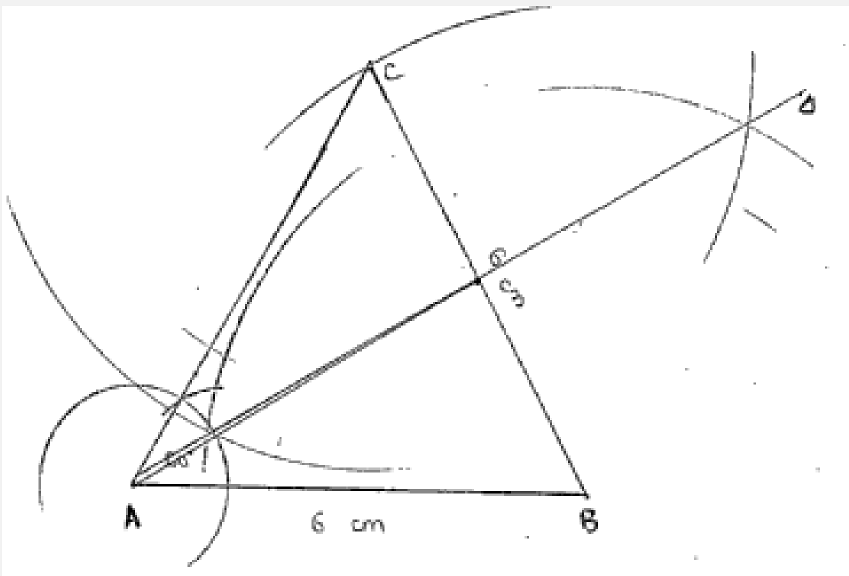
	got full marks. However, some candidates made errors in scalar multiplication and multiplication of matrices; consequently, they were not able to find the correct value of the matrix *X*.
Description of Better Responses	Better responses reflected understanding of the scalar multiplication, matrix multiplication and subtraction. Candidates with better responses executed calculations accurately by multiplying with 2 and the column matrix and then subtracted from the RHS correctly.
Image of Better Response	$X+2\begin{bmatrix}1 & -1\\ 1 & 0\end{bmatrix}\begin{bmatrix}3\\ 2\end{bmatrix}=\begin{bmatrix}-1\\ 1\end{bmatrix}$ $X+\begin{bmatrix}2 & -2\\ 2 & 0\end{bmatrix}\begin{bmatrix}3\\ 2\end{bmatrix}=\begin{bmatrix}-1\\ 1\end{bmatrix}$ $X+\begin{bmatrix}2\times 3+(-2)\times 2\\ 2\times 3+0\times 2\end{bmatrix}=\begin{bmatrix}-1\\ 1\end{bmatrix}$ $X+\begin{bmatrix}6+(-4)\\ 6+0\end{bmatrix}=\begin{bmatrix}-1\\ 1\end{bmatrix}$ $X+\begin{bmatrix}2\\ 6\end{bmatrix}=\begin{bmatrix}-1\\ 1\end{bmatrix}$ $X=\begin{bmatrix}-1\\ 1\end{bmatrix}-\begin{bmatrix}2\\ 6\end{bmatrix}$ $X=\begin{bmatrix}-1-2\\ 1-6\end{bmatrix}$ $X=\begin{bmatrix}-3\\ -5\end{bmatrix}$ Ans
Description of Weaker Responses	In weaker responses, many of students managed to multiply the matrix by 2 and the column matrix correctly. However, they made errors in subtracting it from the RHS to find out the matrix for *x*. Moreover, instead of performing the required subtraction, it was observed that some candidates multiplied the obtained matrix with the right-hand side. This led them to incorrect matrix of *x*.

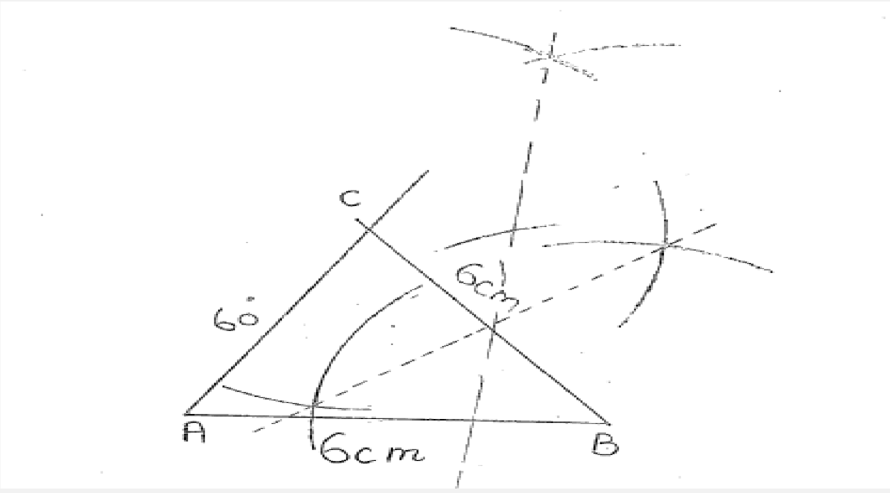
Image of Weaker Response	$= x + 2\begin{bmatrix} 1 & -1 \\ 1 & 0 \end{bmatrix}\begin{bmatrix} 3 \\ 2 \end{bmatrix} = \begin{bmatrix} -1 \\ 1 \end{bmatrix}$ $= x + \begin{bmatrix} 2 & -2 \\ 2 & 0 \end{bmatrix}\begin{bmatrix} 3 \\ 2 \end{bmatrix} = \begin{bmatrix} -1 \\ 1 \end{bmatrix}$ $= x + \begin{bmatrix} 2\times 3 & -2\times 2 \\ 2\times 3 & 0\times 2 \end{bmatrix} = \begin{bmatrix} -1 \\ 1 \end{bmatrix}$ $x + \begin{bmatrix} 6 & -4 \\ 6 & 0 \end{bmatrix} = \begin{bmatrix} -1 \\ 1 \end{bmatrix}$ $\begin{bmatrix} 6 & -4 \\ 6 & 0 \end{bmatrix}\begin{bmatrix} -1 \\ 1 \end{bmatrix} = x$ $\begin{bmatrix} 6\times -1 & -4\times 1 \\ 6\times -1 & 0\times 1 \end{bmatrix} = x$ $\begin{bmatrix} -6 & -4 \\ -6 & 0 \end{bmatrix} = x$

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	• Story Board • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual resources • Think, Pair and Share • Questioning Technique (Socratic approach) • Practical Demonstration	• Past paper questions • Discussion on E-Marking Notes • AKU-EB Digital Learning Solution powered by Knowledge Platform https://akueb.knowledgeplatform.com/login

Any Additional Suggestion:
To enhance better understanding of the concept, teachers are recommended to use the following strategies: Begin with simple matrix equations and provide step-by-step examples. Demonstrate how to isolate the variable matrix by applying matrix operations like addition, subtraction, multiplication, and inversion. Use matrix-solving software or calculators to demonstrate solutions to matrix equations. Encourage students to use these tools for practice and verification i.e., mathstools and Symbolab. Provide examples of common errors that students might make when solving matrix equations. Discuss these errors and how to avoid them.

Question No. 9	
Question Text	Using a compass, draw i. a triangle ABC when AB = BC = 6 cm and $\angle A = 60°$. ii. the median AD for the triangle joining A to BC.
SLO No:	10.1.1/10.1.2c
SLO Text	Draw a triangle when a) two sides and one angle are given. Draw for a given triangle c) median.
Max Marks	3
Cognitive Level	A
Checking Hints	i. 1 mark drawing angle of angle A, 60◦. 1 mark for completing the triangle ABC. ii. 1 mark for mark for drawing the median AD.
Overall Performance	This question demanded candidates to draw a triangle and its particular median, with the given information, using a compass. Many candidates got full marks by meeting the demand of the question. The common errors observed were that candidates we unable to recognise median and drew the triangle with the given specification.
Description of Better Responses	candidates demonstrated a clear grasp of geometric concepts. In part (i), they accurately recreated the specified 60° angle at vertex A by compass. Additionally, such candidates constructed triangle ABC, accurately representing sides AB and BC as 6 cm each. In part (ii), they successfully marked median AD within the triangle.
Image of Better Response	

Description of Weaker Responses	Weaker responses demonstrated lack of clarity in drawing triangle with given sides and angle. Moreover, such responses could not recognise the median to be that was required to be drawn. Furthermore, candidates reflected weaker understanding of the concept of median.
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	• Story Board • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual resources • Think, Pair and Share • Questioning Technique (Socratic approach) • Practical Demonstration	• Past paper questions • Discussion on E-Marking Notes • AKU-EB Digital Learning Solution powered by Knowledge Platform https://akueb.knowledgeplatform.com/login

Any Additional Suggestion:

To enhance better understanding of the concept, teachers are recommended to use the following strategies.

Introduction to Software: Introduce students to geometric software tools like GeoGebra or Desmos that facilitate dynamic geometry constructions.

Presentations and Discussions: Ask students to present their constructed triangles and explain their reasoning. Foster classroom discussions about different approaches and strategies.

Field Trip or Virtual Exploration: If possible, arrange a field trip to a location where students can observe triangular structures (e.g., pyramids, bridges). Alternatively, use virtual tours and images.

Reflective Observation: Ask students to observe and analyse the triangular structures they encounter during the field trip or virtual exploration. Prompt them to identify angles, sides, and potential medians

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

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

These contributors include:

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