آغا خان یونیورسٹی ایگزامینیشن بورڈ

AGA KHAN UNIVERSITY EXAMINATION BOARD

Notes from E-Marking Centre on SSC-II Physics Annual Examinations 2024

Introduction

This document has been produced for the teachers and candidates of Secondary School Certificate (SSC) Part II Physics. It contains comments on candidates' responses to the 2024 SSC-II Examination indicating the quality of the responses and highlighting their relative strengths and weaknesses.

E-Marking Notes

This includes overall comments on candidates' performance on every question and *some* specific examples of candidates' responses that support the mentioned comments. Please note that the descriptive comments represent an overall perception of the better and weaker responses as gathered from the e-marking session. However, the candidates' responses shared in this document represent some specific 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

Generally, candidates demonstrated a strong understanding of the concepts including optics, current electricity and electrostatic. However, certain areas need improvement to ensure a more thorough understanding such as information technology, nuclear physics and electromagnetism.

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

DETAILED COMMENTS

Constructed Response Questions (CRQs)

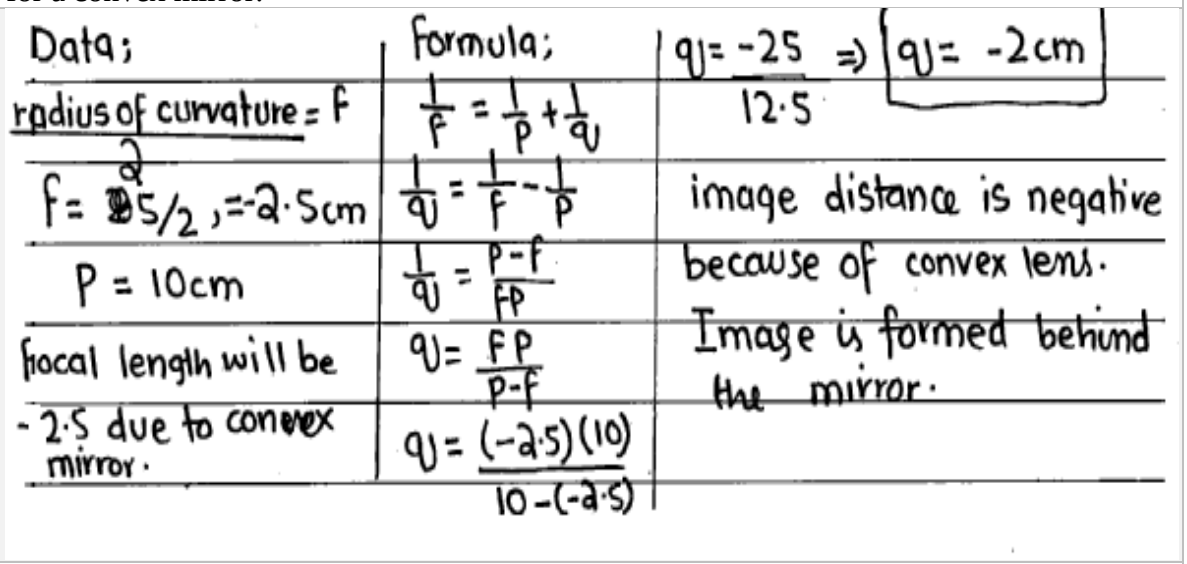
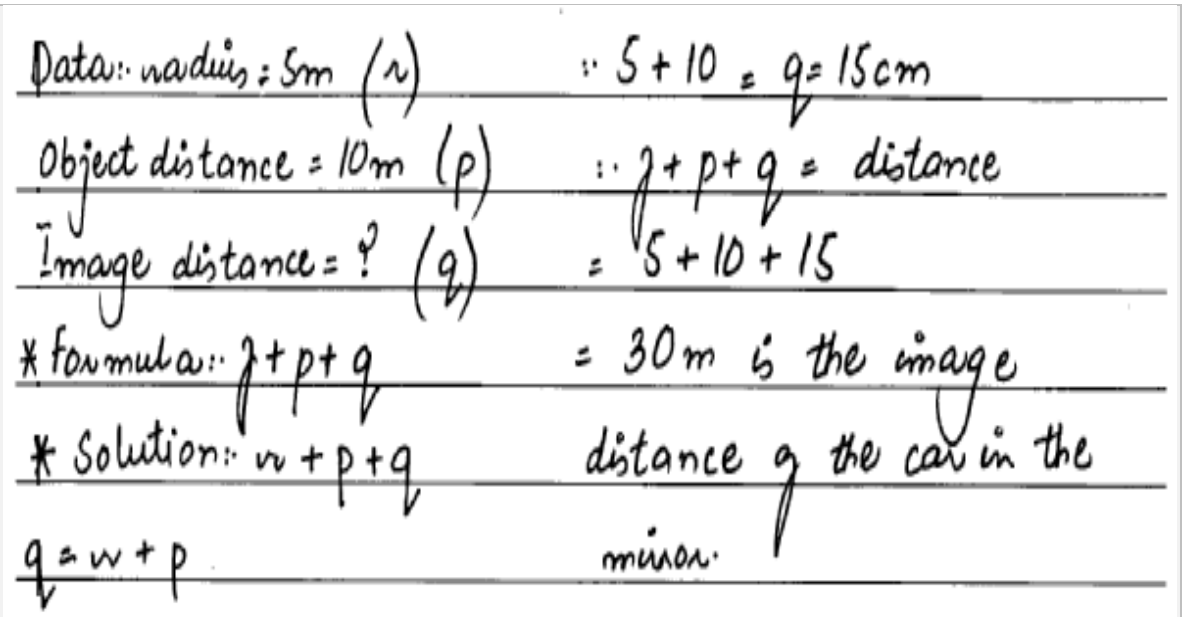
Question No. 1	
Question Text	A bus has a rear-view mirror which is convex with 5 m radius of curvature. If a car is located at 10 m from the mirror, then find the image distance of the car in the mirror.
SLO No.	12.2.1
SLO Text	Solve word problems related to the image location by spherical mirrors using mirror formula.
Max Marks	03
Cognitive Level	A*
Checking Hints	1 mark for finding the focal length 1 mark for writing the correct mirror formula 1 mark for finding the value of image distance
Overall Performance	The overall response to this question was positive. Candidates accurately applied the mirror equation ($1/f = 1/p + 1/q$), correctly determining the image position by effectively using the radius of curvature and object distance. These responses were precise and well-explained, reflecting a solid grasp of mirror optics. However, some responses often contained errors in applying the formula or interpreting the given parameters, leading to inaccurate calculations.
Description of Better Responses	In *better responses,* candidates effectively demonstrated how to calculate the image position using a convex mirror when provided with the radius of curvature and object distance. Candidates accurately applied the mirror equation and correctly determined the image position. Their calculations were precise and clearly explained each step, showcasing a strong grasp of the relationship between the object distance, focal length and image position for a convex mirror.
Image of Better Response	
Description of Weaker Responses	In *weaker responses,* candidates struggled to accurately calculate the image position using a convex mirror. Several responses contained errors in applying the mirror equation or misinterpreted the given radius of curvature and object distance. A common issue was misinterpreting or overlooking the importance of signs (+/-) in formula application, leading to errors in determining image position.

Image of Weaker Response	

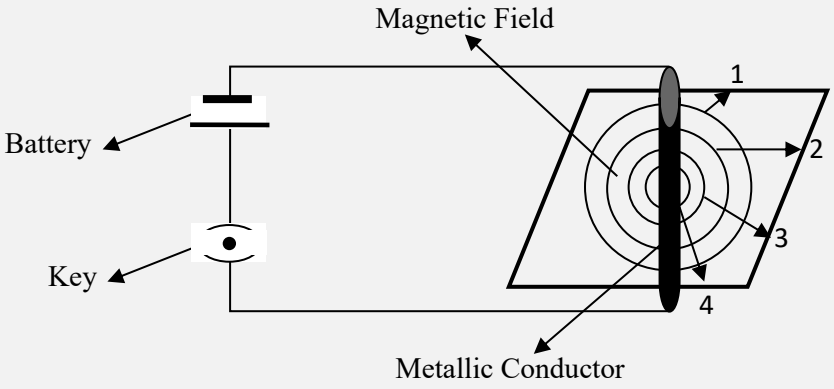
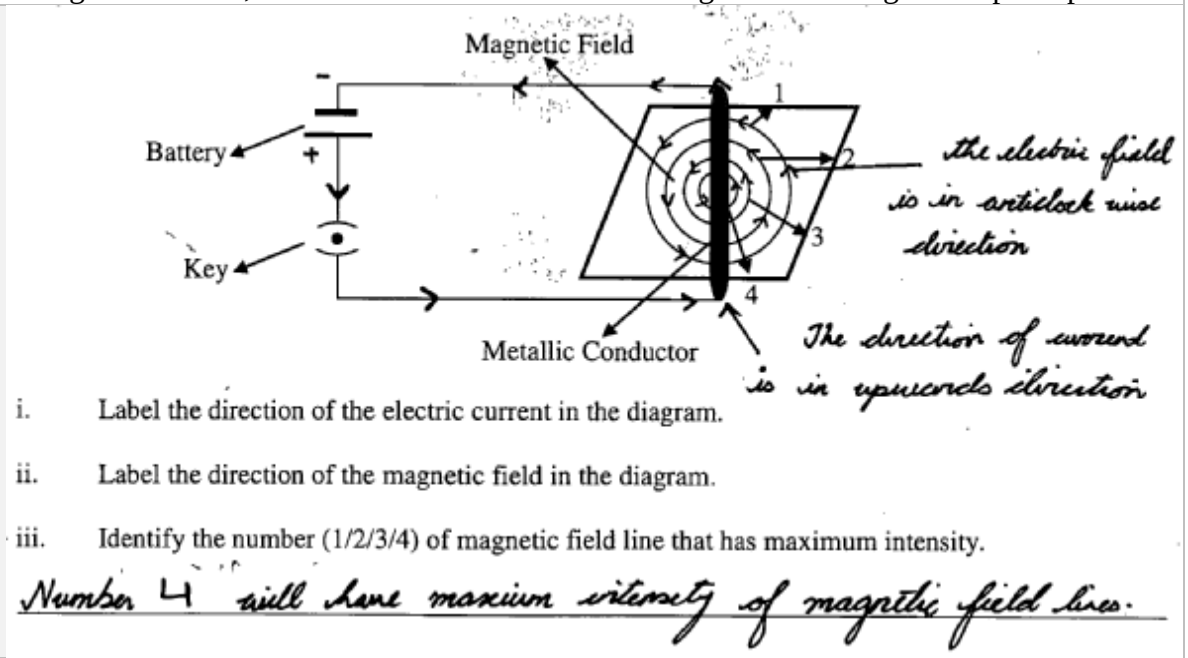
Suggestions for improvement (Highlight all that apply)

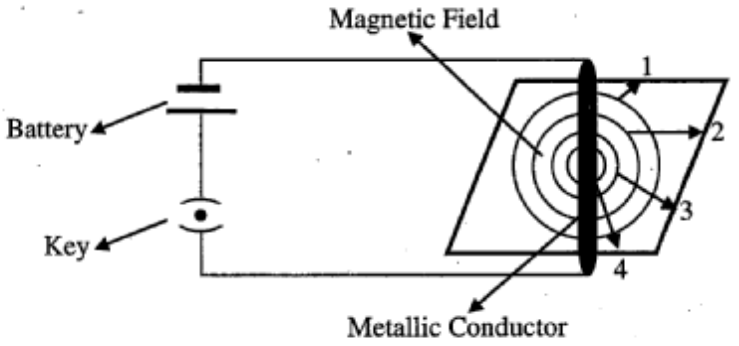
Maximising SLO Achievement	**Preferred Pedagogy** Used for this SLO**	**Assessment Strategies**
• Identify the expectation of command words (use Command Word Guide) • Ensure the content is taught at the relevant cognitive level • Identify necessary content required (skills + concepts) • Review past paper questions on the concept • Utilise the resource guide for additional materials	• Story Board • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual Resources • Think, Pair and Share • Knowledge Platform videos • Questioning Technique (Socratic approach) • Practical Demonstration ** For description of each Pedagogy, refer to Annexure A	• Past paper questions • Discussion on E-Marking Notes • AKU-EB Digital Learning Solution powered by Knowledge Platform https://akueb.knowledgeplatform.com/login

Any Additional Suggestion:

- Teachers must encourage collaboration and peer discussion among candidates to reinforce learning and address common misconceptions.
- Subject teachers should encourage candidates to double-check their calculations to ensure accuracy, especially with signs (+/-) in formula applications.
- Ensure accurate application of the mirror equation and a clear understanding of how to use the given data to find the correct image position for the students.

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

Question No. 2	
Question Text	The given diagram shows an electric current passes through a metallic conductor and produces magnetic field around it.  i. Label the direction of the electric current in the diagram. ii. Label the direction of the magnetic field in the diagram. iii. Identify the number (1/2/3/4) of magnetic field line that has maximum intensity.
SLO No.	15.1.1
SLO Text	Demonstrate that an electric current in a conductor produces a magnetic field around it.
Max Marks	03
Cognitive Level	U
Checking Hints	1 mark for labelling and identifying in each part (3 required)
Overall Performance	Overall, responses varied in illustrating the direction of current flow and the magnetic field lines around the conductor connected to the battery terminals. Some candidates accurately depicted the field lines, showing the correct direction of current flow and mentioned where the field strength is strongest (closer to the conductor) in the given diagram. These responses were clear and well-explained, reflecting a solid understanding of electromagnetism principles. However, some candidates lacked accuracy in drawing magnetic field lines and failed to properly indicate the variations in field strength.
Description of Better Responses	In *better responses*, candidates clearly and accurately depicted the direction of current flow and the magnetic field lines around the conductor connected to the battery terminals. They effectively illustrated the field lines with proper orientation, showing where the magnetic field strength is strongest. The precision of their diagrams, along with the mention of field strength variations, demonstrated a solid understanding of electromagnetism principles.
Images of Better Responses	

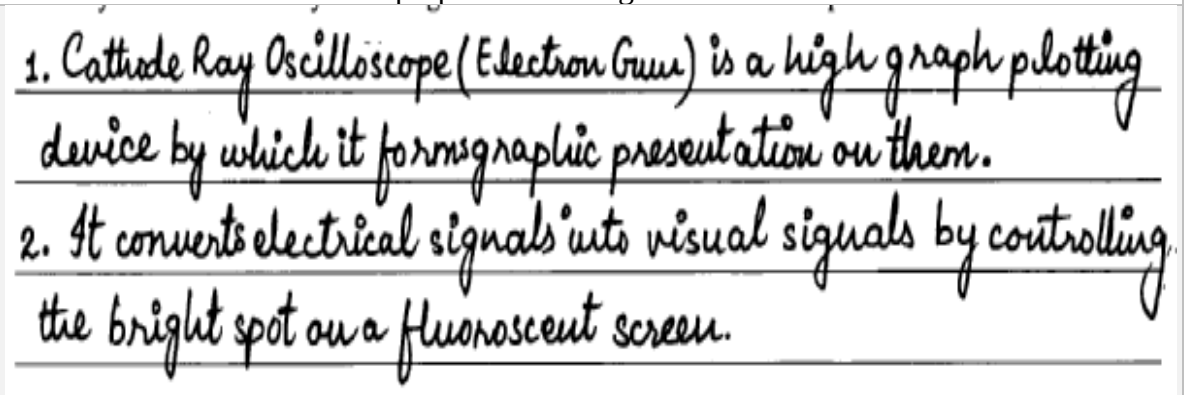
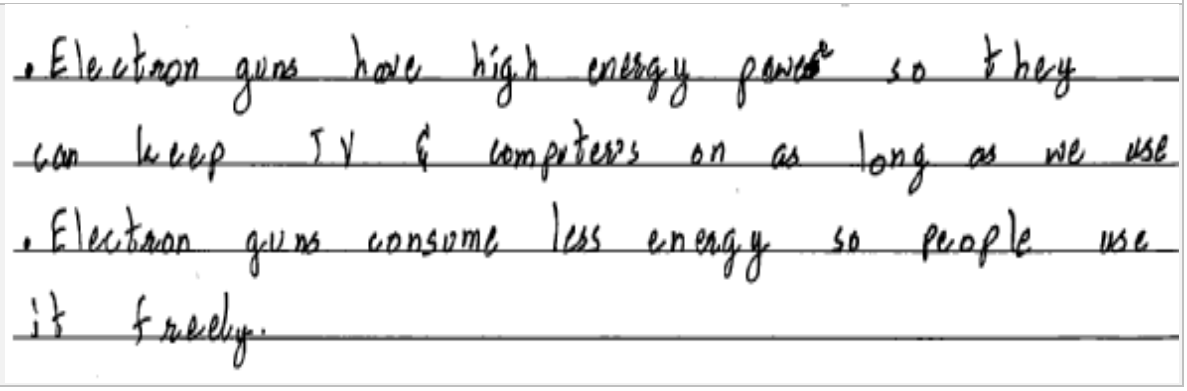
Description of Weaker Responses	In *weaker responses*, candidates lacked clarity in depicting the direction of current flow, they wrongly made the direction on the opposite side of the given lines and the magnetic field lines around the conductor connected to the battery terminals. Many diagrams were either incorrect or incomplete, they were unable to fulfill the demand of the questions showing inaccuracies in the field line patterns and variations in field strength. Some candidates struggled to indicate the regions where the magnetic field strength is strongest and weakest. Some mentioned the farther the magnetic line the stronger be magnetic field strength and some candidates incorrectly wrote about the direction of electric current eastward or westward.
Images of Weaker Responses	 i. Label the direction of the electric current in the diagram. ii. Label the direction of the magnetic field in the diagram. iii. Identify the number (1/2/3/4) of magnetic field line that has maximum intensity. 1, 2, 3 and 4 are range of magnetic field

Suggestions for improvement (Highlight all that apply)

Maximising SLO Achievement	Preferred Pedagogy Used for this SLO	Assessment Strategies
• Identify the expectation of command words (use Command Word Guide) • Ensure the content is taught at the relevant cognitive level • Identify necessary content required (skills + concepts) • Review past paper questions on the concept • Utilise the resource guide for additional materials	• Story Board • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual Resources • Think, Pair and Share • Knowledge Platform videos • Questioning Technique (Socratic approach) Practical Demonstration	• Past paper questions • Discussion on E-Marking Notes • AKU-EB Digital Learning Solution powered by Knowledge Platform https://akueb.knowledgeplatform.com/login

Any Additional Suggestion: Additional Tips:

- Encourage candidates to pay attention to the orientation of the magnetic field lines relative to the conductor (perpendicular orientation using the right-hand rule).
- Teachers should emphasise to their students the importance of clarity and accuracy in their drawings to effectively communicate their understanding.

Question No. 3	
Question Text	Give any TWO reasons why electron gun was used in televisions and computer monitors.
SLO No.	16.2.1
SLO Text	Describe the simple construction and use of an electron gun as a source of electron beam.
Max Marks	02
Cognitive Level	K
Checking Hints	1 mark for writing each reason (Any 2 required)
Overall Performance	Overall, responses varied in explaining the use of a cathode ray oscilloscope (CRO) in televisions and computers. Some candidates accurately described the CRO's role in visualising and analysing electronic signals, which is essential for adjusting and troubleshooting television displays and components. These responses demonstrated a clear understanding of the CRO's importance in television maintenance. However, some responses lacked clarity or accuracy, struggling to explain how the CRO contributes to analysing and managing electronic signals.
Description of Better Responses	*Better responses* effectively explained why a cathode ray oscilloscope (CRO) is used in most televisions and computer monitors, the electrons get directed at the screen and produce light on the screen to create the image. Candidates accurately described the electron gun starting with a small heater, which is a hot, bright filament of the regular light bulb. It heats a cathode, which emits a cloud of electrons and hence, two anodes turn the cloud into an electron beam. Their explanations were detailed, demonstrating a strong understanding of how a CRO contributes to the proper functioning of televisions.
Image of Better Response	
Description of Weaker Responses	In *weaker responses*, candidates struggled to clearly explain the role of a cathode ray oscilloscope (CRO) in televisions. Several answers lacked detail or accuracy, failing to describe how the CRO is used for analysing and adjusting electronic signals in the TV. Some responses did not effectively connect the CRO's function to television troubleshooting and maintenance like CRO increases the life and warranty of the TV sets and computer monitors. In addition to this, they wrote that CRO saves electrical energy and enhances the efficiency of human beings. Additionally, some responses stated irrelevant uses and made references to fission or fusion reactions, which were not required. Furthermore, some candidates merely restated the question without providing essential content.
Image of Weaker Response	

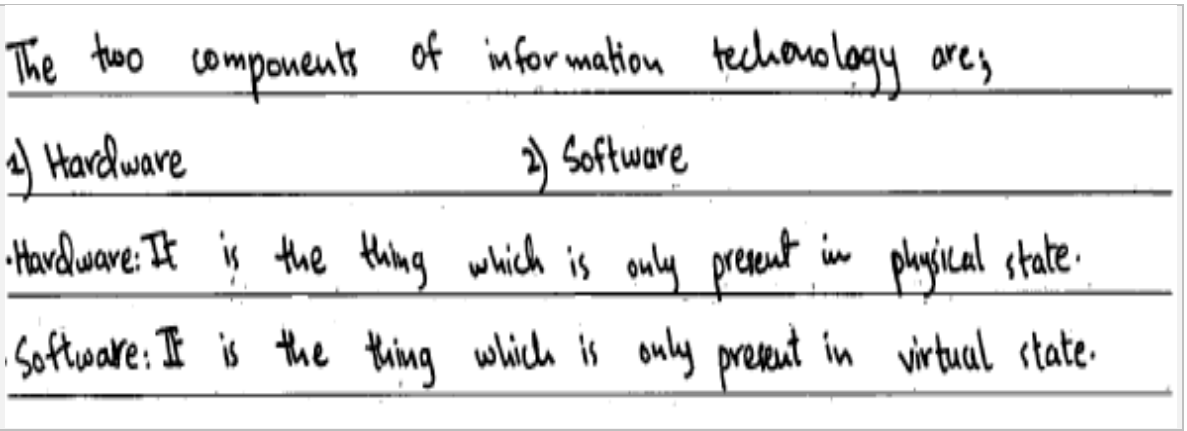
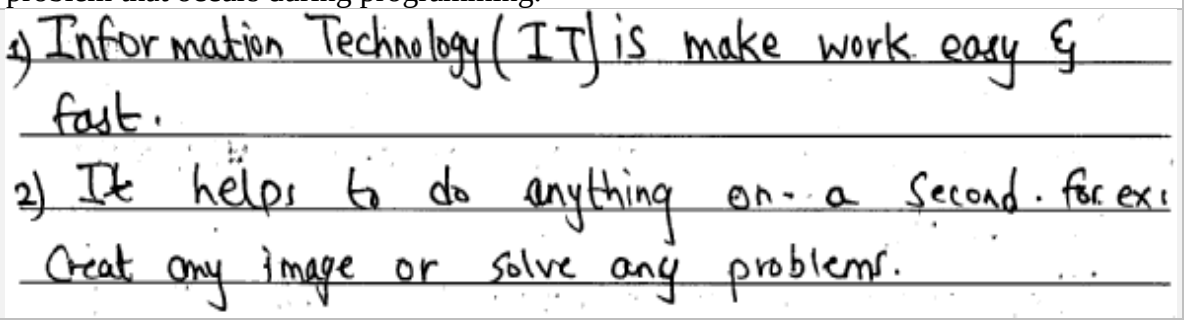
Suggestions for improvement (Highlight all that apply)

Maximising SLO Achievement	Preferred Pedagogy Used for this SLO	Assessment Strategies
• Identify the expectation of command words (use Command Word Guide) • Ensure the content is taught at the relevant cognitive level • Identify necessary content required (skills + concepts) • Review past paper questions on the concept • Utilise the resource guide for additional materials	• Story Board • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual Resources • Think, Pair and Share • Knowledge Platform videos • Questioning Technique (Socratic approach) • Practical Demonstration	• Past paper questions • Discussion on E-Marking Notes • AKU-EB Digital Learning Solution powered by Knowledge Platform https://akueb.knowledgeplatform.com/login

Any Additional Suggestion:

Subject teachers must ensure a thorough understanding of the CRO's function to their students and clearly articulate its role in television sets and computer monitors by showing them different animations, visiting the Physics and Computer labs and demonstrating the working principle of CRO.

Question No. 4	
Question Text	State any TWO components of information technology.
SLO No.	17.1.1
SLO Text	Describe information technology (IT) and the components of information technology. (hardware, software, data, procedure and people)
Max Marks	02
Cognitive Level	K
Checking Hints	1 mark for stating each component (Any 2 required)
Overall Performance	Overall, responses varied in identifying the two main components of information technology. Some candidates accurately named and explained components such as hardware and software, providing clear descriptions of their roles and interactions. These candidates demonstrated a solid foundational understanding of the main components of information technology (IT) and IT fundamentals. However, some responses lacked clarity or detail, struggling to accurately identify or explain the key components.
Description of Better Responses	*Better responses* identified and explained two main parts of information technology: hardware and software. They pointed out the key areas, describing what each one does and how they work together in IT systems. The answers were clear and showed a strong understanding of the basic elements of information technology. In addition to this, they correctly wrote that 'data, procedures and people' play vital roles in the IT-related components. They wrote that data are facts that are used by programs to produce useful information, procedures are sets of instructions and rules to design and use information systems and people design and operate the software, feed input data and build the hardware for the smooth running of any computer base information system (CBIS).

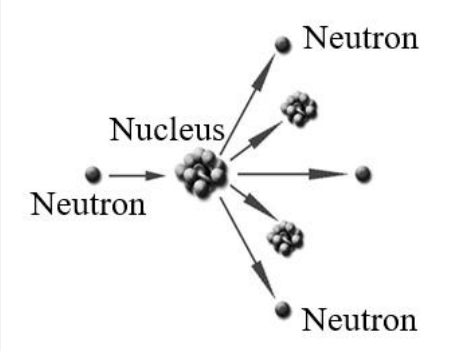
Image of Better Response	
Description of Weaker Responses	In *weaker responses*, candidates struggled to adequately identify or explain the two main components of information technology. Several answers were vague or incorrect, showing a lack of clarity on key areas such as hardware, software, or other essential IT components. Additionally, some candidates did not fully describe the roles or interactions of these components. Candidates wrote that components of IT made human work easy, fast and reliable, making animation more accurate as compared to manual display and solving any problem that occurs during programming.
Image of Weaker Response	

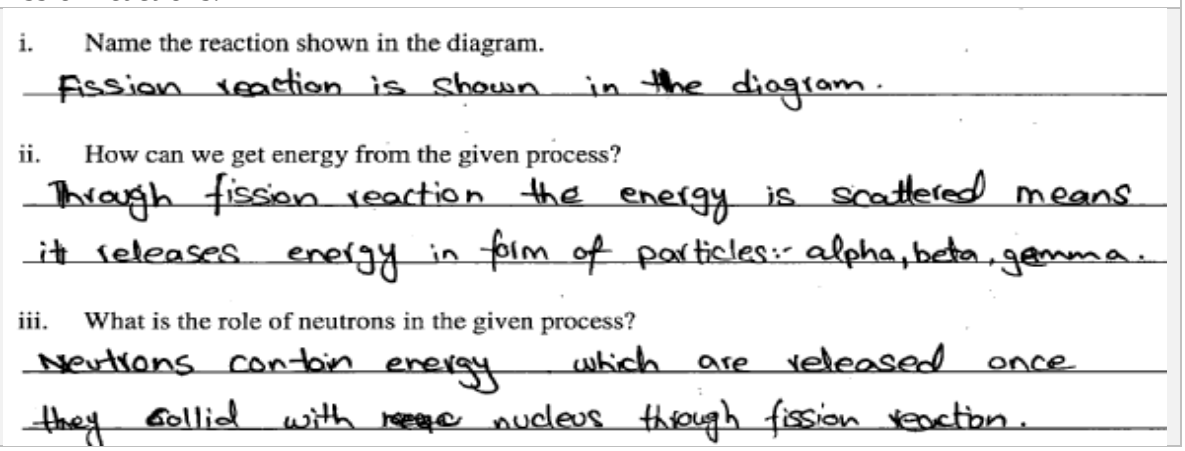
Suggestions for improvement (Highlight all that apply)

Maximising SLO Achievement	Pedagogy Used for that SLO	Assessment Strategies
• Identify the expectation of command words (use Command Word Guide) • Ensure the content is taught at the relevant cognitive level • Identify necessary content required (skills + concepts) • Review past paper questions on the concept • Utilise the resource guide for additional materials	• Story Board • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual Resources • Think, Pair and Share • Knowledge Platform videos • Questioning Technique (Socratic approach) • Practical Demonstration	• Past paper questions • Discussion on E-Marking Notes • AKU-EB Digital Learning Solution powered by Knowledge Platform https://akueb.knowledgeplatform.com/login

Any Additional Suggestion:

- Teachers are encouraged to focus on clearly identifying and explaining the essential elements of information technology and their functions to their students to ensure a comprehensive understanding.
- To further enhance their response, teachers must deepen their explanations, provide specific examples and explore the interconnections between these components within the field of IT by visiting different websites available in their subject-specific resource guides.

Question No. 5	
Question Text	The given diagram shows a nuclear reaction.  i. Name the reaction shown in the diagram. ii. How can we get energy from the given process? iii. What is the role of neutrons in the given process?
SLO No.	18.7.1
SLO Text	Describe the processes and practical applications of fission and fusion.
Max Marks	03
Cognitive Level	U
Checking Hints	1 mark for naming 1 mark for writing the process of energy released 1 mark for the correct role of neutrons
Overall Performance	The overall performance of the cohort varied in identifying the process shown in the diagram and explaining the 'fission chain reaction'. Some candidates accurately identified the process as a fission chain reaction, clearly described the role of neutrons in sustaining the reaction and explained how energy is produced through the splitting of atomic nuclei. These responses demonstrated a solid understanding of nuclear fission. However, some responses struggled to correctly identify the process or lacked detail in explaining the role of neutrons and the energy production mechanism. Additionally, these responses were vague, lacking in detail, or inaccurately describing the process and its components.
Description of Better Responses	*Better responses* effectively identified the process shown in the diagram as a fission chain reaction. Candidates clearly explained the role of neutrons in sustaining the chain reaction by causing additional fissions when they collide with heavy nuclei. Additionally, they accurately described how energy is produced through the fission process, where the splitting of atomic nuclei releases a significant amount of energy. Their explanations were detailed and demonstrated a strong understanding of nuclear fission and its mechanisms.
Image of Better Response	i. Name the reaction shown in the diagram. The reaction shown in the diagram is Nuclear fission". ii. How can we get energy from the given process? we can get energy from this process as when a heavier nucleus is broken into two nucleus so it release a large amount of energy about 200 Mev & three neutrons which are release also give energy. iii. What is the role of neutrons in the given process? The Neutrons are the huge source of energy from released in reaction & they also constitute chain reaction by again splitting two nuclei, Neutron further more reaction as they also conduct react

Description of Weaker Responses	*Weaker responses* did not identify the process shown in the diagram or correctly describe it as a fission chain reaction. Several answers lacked detail on the role of neutrons in maintaining the chain reaction and did not accurately explain how energy is produced. Some responses were vague or incorrect in describing the energy released from fission. Candidates often misidentified the concept of a fission chain reaction, with some merely stating, 'The diagram shows some atoms and lines', which lacks specificity and does not demonstrate an understanding of a fission chain reaction. Regarding the role of neutrons, candidates wrote, 'Neutrons are used to make the atoms move', a vague explanation that fails to clarify how neutrons initiate fission reactions. Additionally, when discussing energy production, candidates simply stated, 'Energy is created when the atoms break,' an overly simplistic response that does not explain the specific mechanism of energy release through fission reactions.
Image of Weaker Response	 i. Name the reaction shown in the diagram. Fission reaction is shown in the diagram. ii. How can we get energy from the given process? Through fission reaction the energy is scattered means it releases energy in form of particles:- alpha, beta, gamma. iii. What is the role of neutrons in the given process? Neutrons contain energy which are released once they collid with nucleus through fission reaction.

Suggestions for improvement (Highlight all that apply)

Maximising SLO Achievement	Pedagogy Used for that SLO	Assessment Strategies
• Identify the expectation of command words (use Command Word Guide) • Ensure the content is taught at the relevant cognitive level • Identify necessary content required (skills + concepts) • Review past paper questions on the concept • Utilise the resource guide for additional materials	• Story Board • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual Resources • Think, Pair and Share • Knowledge Platform videos • Questioning Technique (Socratic approach) • Practical Demonstration	• Past paper questions • Discussion on E-Marking Notes • AKU-EB Digital Learning Solution powered by Knowledge Platform https://akueb.knowledgeplatform.com/login

Any Additional Suggestion:

Teachers are encouraged to focus on accurately identifying the fission chain reaction, understanding the role of neutrons in sustaining the process and clearly explaining how energy is generated in nuclear fission. Many resources are available in the subject-specific resource guide which will help students to fully understand the fission and fusion reactions.

Extended Response Questions (ERQs)

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

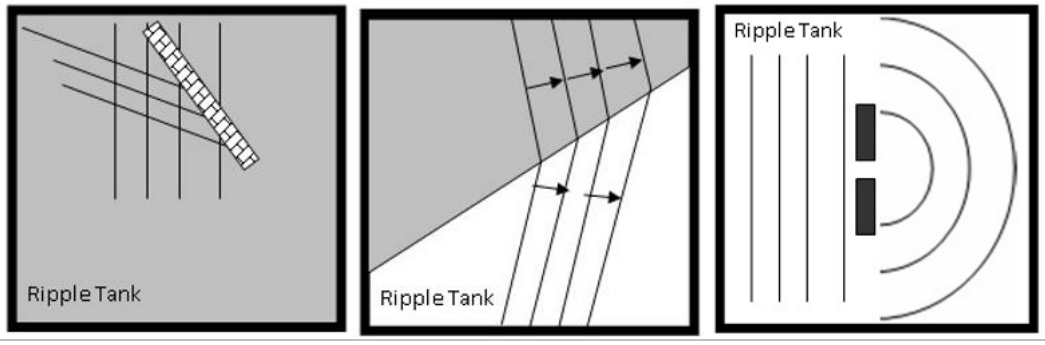
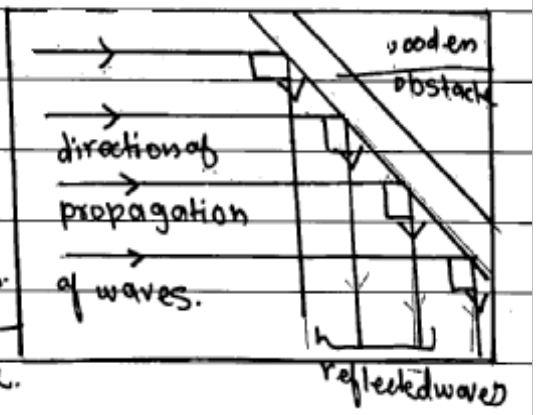
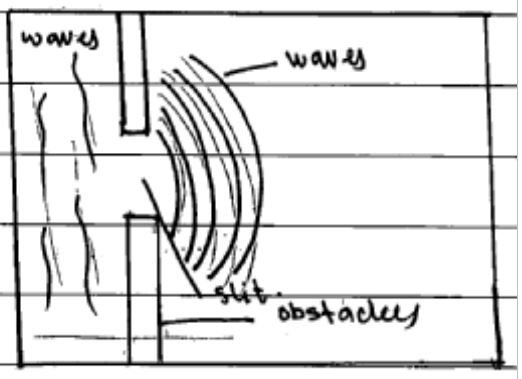
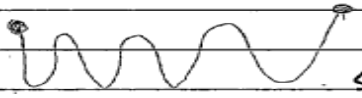
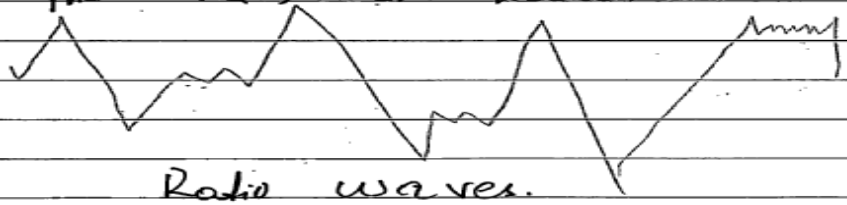
Question No. 6a	
Question Text	With the help of a ripple tank, describe any TWO properties of waves. (4 Marks) Support your answer by drawing a ray diagram for any TWO properties.
SLO No.	10.3.1
SLO Text	Describe properties of waves such as reflection, refraction and diffraction with the help of ripple tank.
Max Marks	06
Cognitive Level	U
Checking Hints	2 marks for any 1 property (2 required) 1 mark for making 1 ray diagram (2 required)
Overall Performance	The overall performance on this question was positive and this part of the question was attempted by the majority of the candidates. The explanations of wave properties were accurate and detailed, with clear, well-labelled diagrams that effectively illustrated the concepts. These responses were concise, relevant and accurately presented, demonstrating a strong understanding of the topic. Candidates wrote that the **reflection** of water waves is observed by generating straight waves in a ripple tank. Place a plane surface obstacle in the path of the waves making an angle with the direction of the propagation of waves. After striking the obstacle the path of the waves will be reflected in a particular direction. While writing about the **refraction**, they wrote that the speed of water waves depends on the depth of the water. Its speed reduces when enters shallow water and makes two different depths in the ripple tank by covering half a portion of the bottom of the ripple tank with a thick glass plate. In the end about **diffraction,** candidates wrote that the water wave after passing through the split between two obstacles, spreads in all directions and changes into a circular form and this bending of waves around the corners or obstacles is called diffraction.
Description of Better Responses	*Better responses* were excellent, providing a thorough and accurate explanation of the two wave properties, such as wavelength and frequency. The definitions were clear and correct as mentioned in the overall performance part, demonstrating a strong grasp of wave behaviour. Additionally, the accompanying diagrams were well-drawn and effectively illustrated the properties, making the concepts easier to understand. The explanations were relevant and concise, avoiding unnecessary details. They made the most accurate diagrams as well in their explanations, these diagrams are as under. 

Image of Better Response	a. Reflection: Reflection is a propeity of water where water waves reflect back when they hit an obstacle and creates specific angles with the waves.  Diffraction: This is a characteristic of water where, the water waves diffreat, means that if there is a slight slit/opening in the obstacle, the waves pass through it and creates semi circular waves. 
Description of Weaker Responses	In *weaker responses*, candidates struggled to clearly and accurately explain wave properties. The definitions provided were either incorrect or incomplete, leading to misunderstandings about the concepts. Diagrams were either missing or not well-labelled as mentioned in the image of weaker response, they made longitudinal and transverse waves in their explanation and incorrectly wrote about the types of waves like sound, light, and radio waves. They also mentioned compression and rarefaction, in addition to this they wrote that waves are the energy carrier and produce ripple tanks.
Image of Weaker Response	Sound waves. Sound wave is Peoperey of sound which we can head it on our society.  sound waves Radio waves Radio waves are bad like waves which as only use basicaly in hospitals for check. The vales of heart.  Radio waves.

Suggestions for improvement (Highlight all that apply)

Maximising SLO Achievement	Preferred Pedagogy Used for this SLO	Assessment Strategies
• Identify the expectation of command words (use Command Word Guide) • Ensure the content is taught at the relevant cognitive level • Identify necessary content required (skills + concepts) • Review past paper questions on the concept • Utilise the resource guide for additional materials	• Story Board • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual Resources • Think, Pair and Share • Knowledge Platform videos • Questioning Technique (Socratic approach) • Practical Demonstration	• Past paper questions • Discussion on E-Marking Notes • AKU-EB Digital Learning Solution powered by Knowledge Platform https://akueb.knowledgeplatform.com/login

Any Additional Suggestion:

Teachers are encouraged to focus on providing correct definitions, ensuring diagrams are accurate and labelled and presenting information in a clear and organised manner for achieving this, many animations and websites are available in the subject-specific resource guide.

Question No. 6b	
Question Text	i. Write the intensity of faintest audible sound wave. ii. Write the audible frequency range of sound wave. iii. Describe the production mechanism of sound waves in the air.
SLO No.	11.1.1
SLO Text	Explain production of sound waves.
Max Marks	06
Cognitive Level	U
Checking Hints	1 mark for each point (Any 6 required)
Overall Performance	The overall performance on this question varied in quality. The least number of candidates attempted this part of the question. Many candidates provided accurate and clear explanations of sound intensity as 10^{-12} W/m^2, the audible frequency range from 20 Hz to 20.000 Hz and the mechanism of sound wave production in air. They wrote in the third part of the question that the production of sound waves exists on the variations of pressure in a medium, generated by the vibration of an object, which causes the air surrounding it to vibrate. The vibrating object moves in one direction and compresses the air directly in front of it and as the vibrating object moves in the opposite direction, the pressure on the air is lessened so that an expansion or rarefaction of air molecules occurs. The vibrating air molecules move back and forth parallel to the direction of motion of the wave receiving energy from adjacent molecules nearer the source and passing the energy to adjacent molecules farther from the source finally, the vibrating air then causes the human eardrum to vibrate, which the brain interprets as sound.

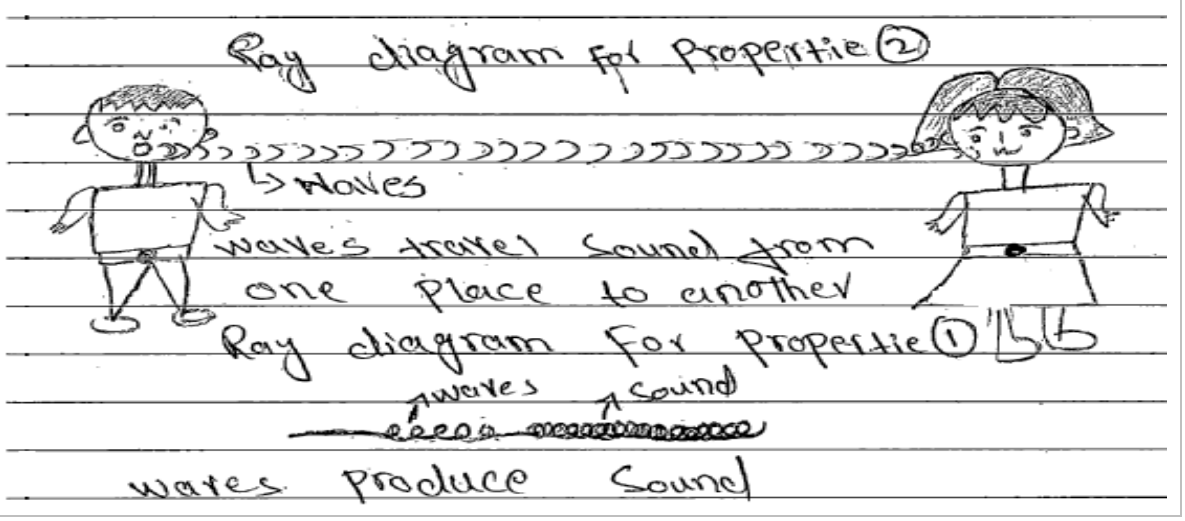
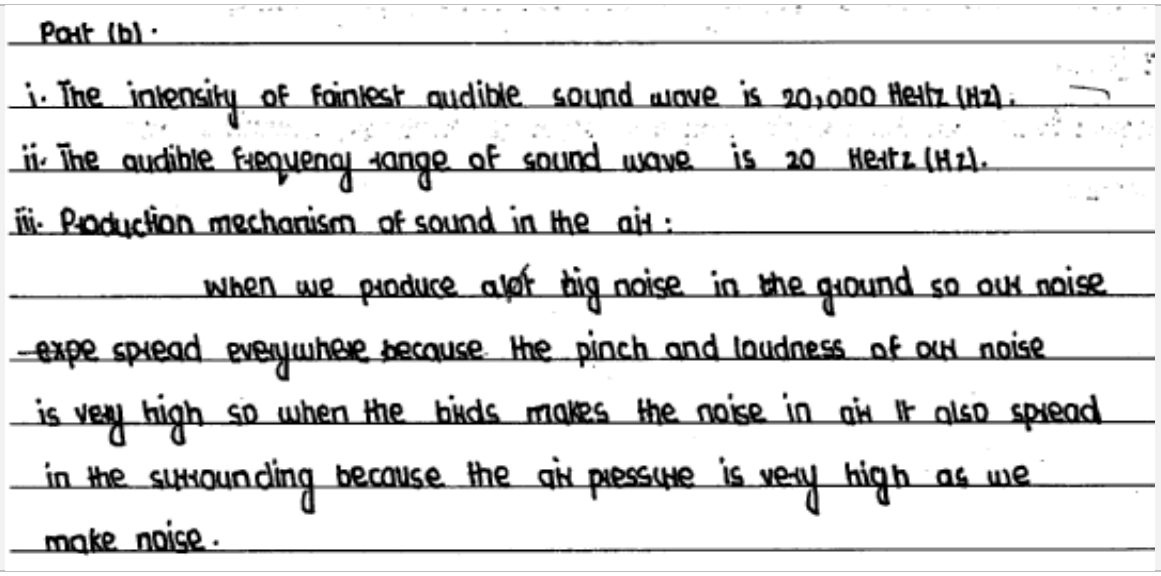
Description of Better Responses	*Better responses* were well-executed and provided clear and accurate explanations of the intensity of faint sounds, the audible frequency range and the mechanism of sound wave production in air as mentioned in the overall performance part. Candidates effectively described the relationship between sound intensity and perception, accurately outlined the range of frequencies humans can hear, and provided a detailed explanation of how sound waves propagate through air. Overall, their thorough and precise responses reflected a strong grasp of the subject matter and contributed to a comprehensive understanding of sound phenomena.
Image of Better Response	(i) Faintest audible intensity of sound wave; faintest = 10^{-12} Wm^{-2} in decibels 120db (ii) Audible frequency range is 20hz — 20,000hz. (iii) Production of sound waves in air: When a object moves it vibrates air particles around it, this vibration cause air to form compression and rarefaction, (like the longitudnal waves) These disturbted air particles form waves in air (sound waves) according to the movement of moving object. When these sound waves produced in air strike our eardrum, we sense sound. Sound is travelled through air, it need medium, it is mechanical wave, hence the vibration of object cause particles to form compression and rarefaction region which the produce sound.
Description of Weaker Responses	*Weaker responses* were lacking in several areas. Descriptions of the intensity of faint sounds were often inaccurate or incomplete, and the audible frequency range was sometimes not defined properly or incorrectly. Additionally, explanations of how sound waves were produced and traveled through the air were often vague or lacked detail. Candidates mixed up the faintest audible and frequency range of the sound waves. They wrote about electromagnetic waves, loudness, pitch and wavelength of sound waves which were demanded in the question. Some of the candidates made irrelevant diagrams as mentioned below.
	

Image of Weaker Response	

Part (b):

i. The intensity of faintest audible sound wave is 20,000 Heitz (Hz).

ii. The audible frequency range of sound wave is 20 Heitz (Hz).

iii. Production mechanism of sound in the air:

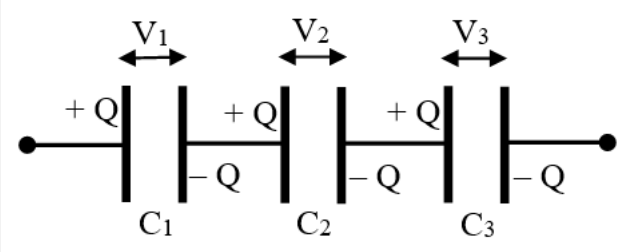
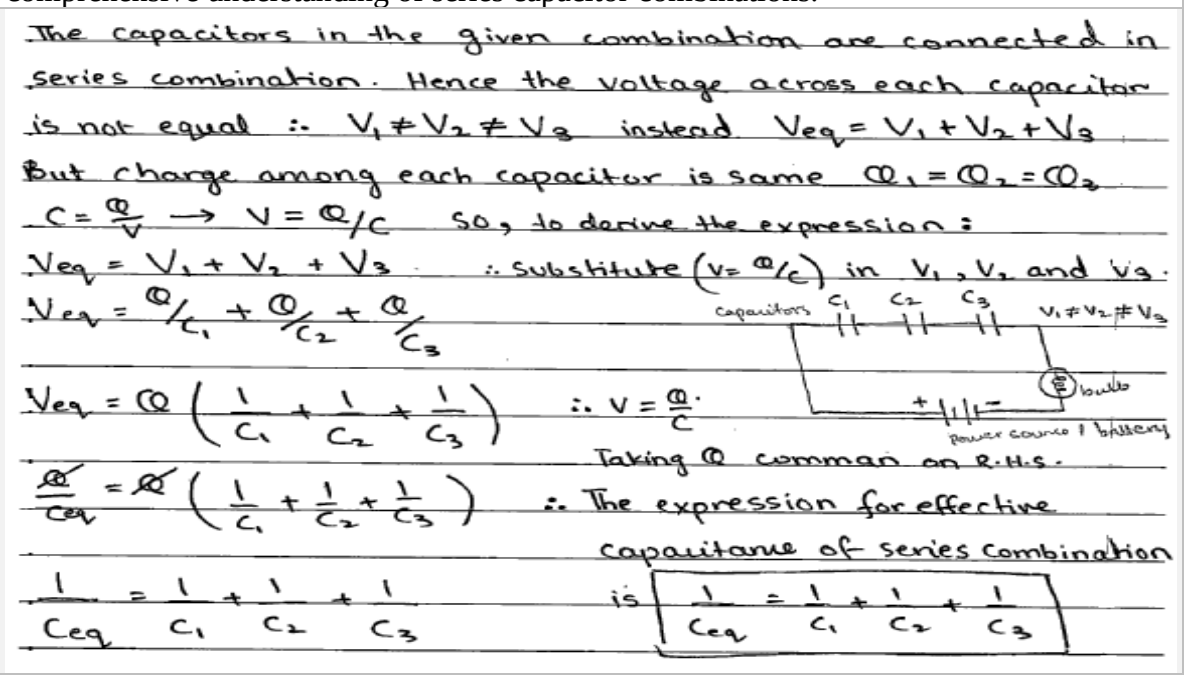
when we produce a big noise in the ground so our noise expe spread everywhere because the pinch and loudness of our noise is very high so when the birds makes the noise in air it also spread in the surrounding because the air pressure is very high as we make noise.

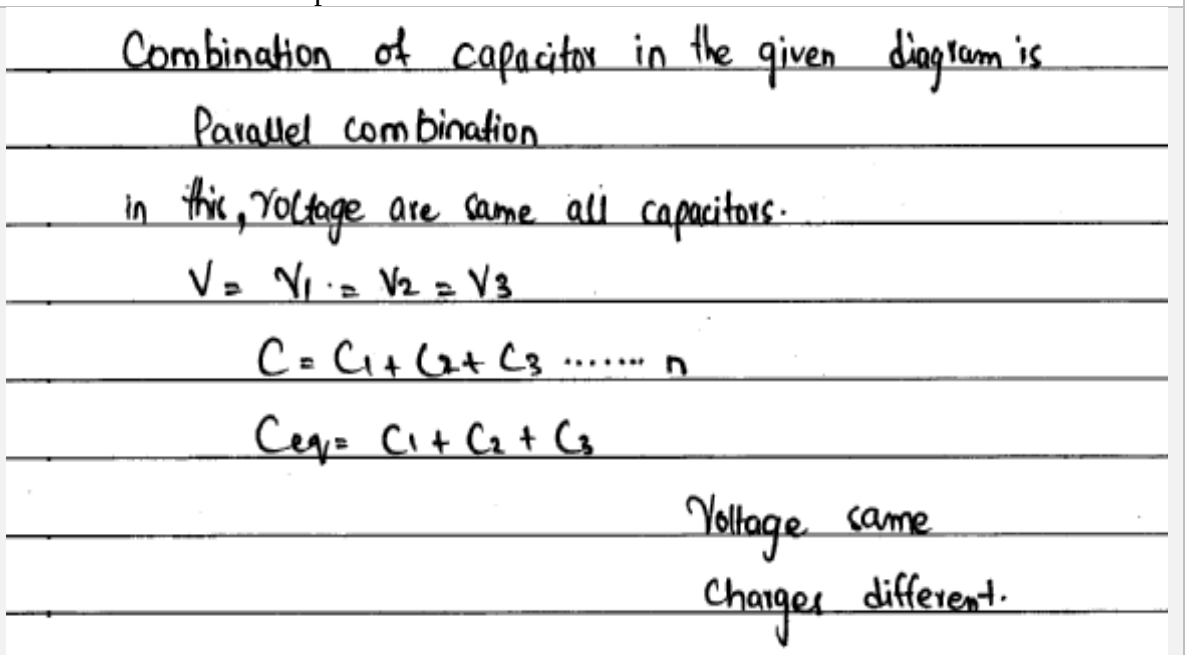
Suggestions for improvement (Highlight all that apply)

Maximising SLO Achievement	**Preferred Pedagogy Used for this SLO**	**Assessment Strategies**
• Identify the expectation of command words (use Command Word Guide) • Ensure the content is taught at the relevant cognitive level • Identify necessary content required (skills + concepts) • Review past paper questions on the concept • Utilise the resource guide for additional materials	• Story Board • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual Resources • Think, Pair and Share • Knowledge Platform videos • Questioning Technique (Socratic approach) • Practical Demonstration	• Past paper questions • Discussion on E-Marking Notes • AKU-EB Digital Learning Solution powered by Knowledge Platform https://akueb.knowledgeplatform.com/login

Any Additional Suggestion:

Teachers are encouraged to focus on delivering precise definitions, thorough explanations and detailed descriptions during their lectures. Many resources are also available in the subject-specific resource guide.

Question No. 7a	
Question Text	i. Identify the combination of capacitors in the given diagram. (1 Mark)  ii. Derive an expression for the effective capacitance of the combination identified in part i.
SLO No.	13.8.3
SLO Text	Derive the formula for the effective/ equivalent capacitance of a number of capacitors connected in series and in parallel.
Max Marks	06
Cognitive Level	A
Checking Hints	1 mark for the correct identification 1 mark for each step (5 required)
Overall Performance	The majority of the candidates attempted this part of the question. Most candidates correctly identified the capacitor combination as a 'series' and provided a clear, accurate derivation of the equivalent capacitance formula ($1/C_{eq} = 1/C_1 + 1/C_2 + 1/C_3$), demonstrating a strong understanding of the concept. These responses were thorough and well-organised. However, errors in identification or derivation, such as incorrect results or incomplete explanations, diminished the effectiveness of some responses.
Description of Better Responses	*Better responses* demonstrated a strong understanding of capacitor combinations. They accurately identified the capacitors as being in a 'series combination of capacitors' and provided a precise derivation of the equivalent capacitance formulas ($V = V_1 + V_2 + V_3$) and $1/C_{eq} = 1/C_1 + 1/C_2 + 1/C_3$). Their mathematical manipulation and articulation were clear and well-structured, making it easy to follow each step of the derivation. The thoroughness and accuracy in both identification and derivation reflected a solid grasp of the concept. Overall, their well-organized and detailed responses contributed to a comprehensive understanding of series capacitor combinations.
Image of Better Response	 The capacitors in the given combination are connected in series combination. Hence the voltage across each capacitor is not equal ∴ $V_1 \neq V_2 \neq V_3$ instead $V_{eq} = V_1 + V_2 + V_3$ But charge among each capacitor is same $Q_1 = Q_2 = Q_3$ $C = \frac{Q}{V} \rightarrow V = Q/C$ so, to derive the expression : $V_{eq} = V_1 + V_2 + V_3$ ∴ Substitute $(V = Q/C)$ in V_1, V_2 and V_3. $V_{eq} = \frac{Q}{C_1} + \frac{Q}{C_2} + \frac{Q}{C_3}$ $V_{eq} = Q\left(\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}\right)$ ∴ $V = \frac{Q}{C}$. Taking Q comman on R.H.S. $\frac{Q}{C_{eq}} = Q\left(\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}\right)$ ∴ The expression for effective capacitance of series combination $\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$ is $\boxed{\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}}$ capacitors C_1 C_2 C_3 $V_1 \neq V_2 \neq V_3$ bulb power source / battery

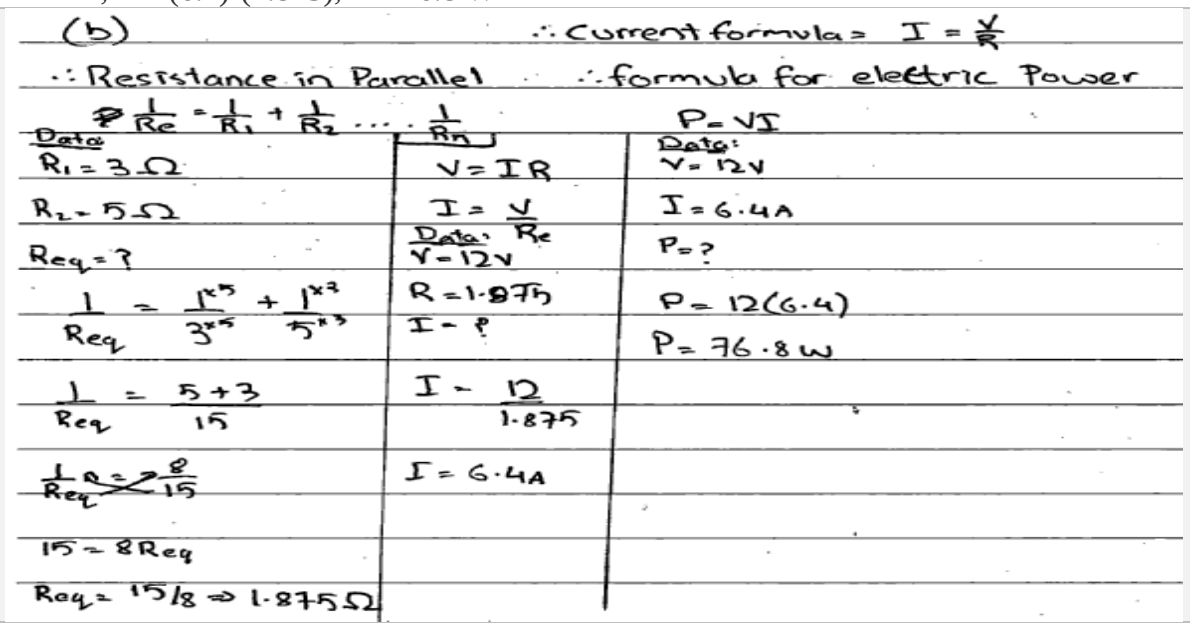
Description of Weaker Responses	*Weaker responses* needed improvement as they contained inaccuracies in identifying the capacitor combination or deriving the equivalent capacitance. They wrote the combination of the capacitors was 'parallel' and therefore, derived an expression for the effective capacitance of the parallel combination. Some of the candidates wrote the definition of series and parallel combinations of capacitors and few of the candidates mixed up the derivation of series and parallel combinations.
Image of Weaker Response	

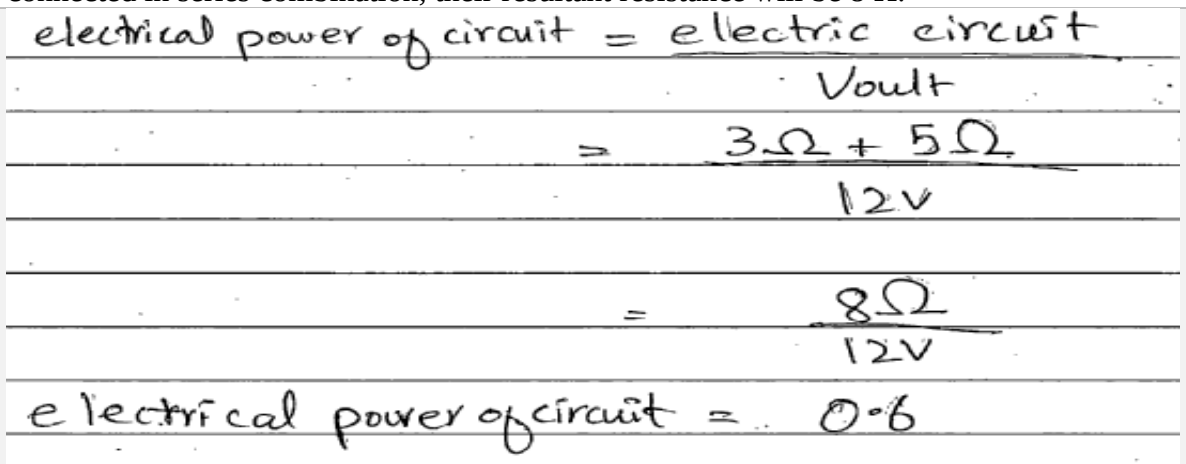
Suggestions for improvement (Highlight all that apply)

Maximising SLO Achievement	Pedagogy Used for that SLO	Assessment Strategies
• Identify the expectation of command words (use Command Word Guide) • Ensure the content is taught at the relevant cognitive level • Identify necessary content required (skills + concepts) • Review past paper questions on the concept • Utilise the resource guide for additional materials	• Story Board • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual Resources • Think, Pair and Share • Knowledge Platform videos • Questioning Technique (Socratic approach) • Practical Demonstration	• Past paper questions • Discussion on E-Marking Notes • AKU-EB Digital Learning Solution powered by Knowledge Platform https://akueb.knowledgeplatform.com/login

Any Additional Suggestion:

- Subject teachers are requested to effectively teach the differences between series and parallel combinations of capacitors and resistances by providing a straightforward explanation of what series and parallel combinations are in the context of capacitors and resistances, using diagrams, schematics, or interactive simulations to illustrate the concepts of series and parallel combinations.
- If possible, teachers may conduct hands-on demonstrations in the classroom to physically show how series and parallel combinations work. This can include setting up circuits with real capacitors and resistors and assigning homework and practice problems that require candidates to apply their knowledge of series and parallel combinations.

Question No. 7b	
Question Text	In an electric circuit, 3 Ω and 5 Ω resistors are connected in parallel combination across a source of 12 V. Calculate the electrical power of the circuit.
SLO No.	14.6.3
SLO Text	Apply the equation $E = IVt = I^2Rt = V\,t / R$ to solve word problems.
Max Marks	06
Cognitive Level	A
Checking Hints	1 mark for writing the correct formula of resistance 1 mark for finding the total resistance 1 mark for writing the correct formula of Ohm's law 1 mark for finding the total current 1 mark for writing the correct formula for electrical power 1 mark for calculating the correct value of electrical power
Overall Performance	Some of the candidates accurately calculated the electrical power for two resistors connected in parallel with a battery, using correct formulas ($1/R_{eq} = 1/R_1 + 1/R_2$, $V = I\,R$ and $P = I^2R$) and providing clear, well-organised explanations. These responses demonstrated a strong grasp of the principles and effective calculation skills. In contrast, some responses often contained errors in formulas' application or calculation steps, leading to incorrect power values and unclear explanations.
Description of Better Responses	Many responses were exemplary and accurately calculated the electrical power for two resistors connected in parallel with a battery. Candidates used the appropriate formulas as mentioned in the overall performance part and clearly outlined each step of calculations, demonstrating a strong understanding of the principles involved. Some of the candidates exactly follow the mathematical steps present in the marking scheme as $1/R_{eq} = 1/R_1 + 1/R_2$, $1/R_{eq} = 1/3 + 1/5$, $R_{eq} = 1.875\ \Omega$ and $V = I\,R = V / R_{eq}\ I = 12 / 1.875$, $I = 6.4$ A and $P = I^2R$, $P = (6.4)^2(1.875)$, $P = 76.8$ W
Images of Better Responses	

Description of Weaker Responses	*Weaker responses* contained errors in calculating the electrical power for two resistors connected in parallel with a battery. They used incorrect formulas while solving the word problem like Power = Electric circuit / Volts (OR) Power = Resistor × Battery (OR) P = Q / V (OR) P = V / R and I = V R and made errors in calculations led to inaccurate results. Additionally, few of the candidates explained in wording rather than solving word problems. They wrote that when 3 Ω and 5 Ω resistors are connected in parallel combination, they will cancel each other and the resultant resistance will be 0 Ω and when 3 Ω and 5 Ω resistors are connected in series combination, their resultant resistance will be 8 Ω.
Image of Weaker Response	

Suggestions for improvement (Highlight all that apply)

Maximising SLO Achievement	Preferred Pedagogy Used for this SLO	Assessment Strategies
• Identify the expectation of command words (use Command Word Guide) • Ensure the content is taught at the relevant cognitive level • Identify necessary content required (skills + concepts) • Review past paper questions on the concept • Utilise the resource guide for additional materials	• Story Board • Cause and Effect • Fish and Bone • Concept Mapping • Audio Visual Resources • Think, Pair and Share • Knowledge Platform videos • Questioning Technique (Socratic approach) • Practical Demonstration	• Past paper questions • Discussion on E-Marking Notes • AKU-EB Digital Learning Solution powered by Knowledge Platform https://akueb.knowledgeplatform.com/login

Any Additional Suggestion:

- Teachers can guide their students to effectively extract the correct data, use the right formula, and include SI units when solving word problems by explaining the problem-solving process step by step, emphasising the importance of identifying given data and required information, providing plenty of example problems, both in class and as homework, where students practice identifying relevant data and applying the appropriate formula.
- Teach students how to read and analyse word problems carefully, encourage them to underline or highlight key information and clearly state what is given and what is needed, ensure students are familiar with the relevant formulas and equations, encourage critical thinking by asking follow-up questions that require students to justify their choices of data, formulas, and units.

Annexure A: Pedagogies Used for Teaching the SLOs

Pedagogy: Storyboard
Description: A visual pedagogy that uses a series of illustrated panels to present a narrative, encouraging creativity and critical thinking. It helps learners organise ideas, sequence events, and comprehend complex concepts through storytelling.
Example: In a Literature class, students are tasked with creating storyboards to visually retell a novel. They draw key scenes, write captions, and present their stories to the class, enhancing their reading comprehension and fostering their imagination.

Pedagogy: Cause and Effect
Description: This pedagogy explores the relationships between actions and consequences. By analysing cause-and-effect relationships, learners develop a deeper understanding of how events are interconnected and how one action can lead to various outcomes.
Example: In a History class, students study the causes and effects of the Industrial Revolution. They research and discuss how technological advancements in manufacturing led to significant societal changes, such as urbanisation and labour reform movements.

Pedagogy: Fish and Bone
Description: A method that breaks down complex topics into main ideas (the fish) and supporting details (the bones). This visual approach enhances comprehension by highlighting essential concepts and their relevant explanations.
Example: During a Biology class on human anatomy, the teacher uses the fish and bone technique to teach about the human skeletal system. Teacher presents the main components of the human skeleton (fish) and elaborates on each bone's structure and function (bones).

Pedagogy: Concept Mapping
Description: An effective way to visually represent relationships between ideas. Learners create diagrams connecting key concepts, aiding in understanding the overall structure of a subject and fostering retention.
Example: In a Psychology assignment, students use concept mapping to explore the various theories of personality. They interlink different theories, such as Freud's psychoanalysis, Jung's analytical psychology, and Bandura's social-cognitive theory, to see how they relate to each other.

Pedagogy: Audio Visual Resources
Description: Incorporating multimedia elements like videos, images, and audio into lessons. This approach caters to different learning styles, making educational content more engaging and memorable.
Example: In a General Science class, the teacher uses a documentary-style video to teach about the solar system. The video includes stunning visual animations of the planets, interviews with astronomers, and background music, enhancing students' interest and understanding of space.

Pedagogy: Think, Pair, and Share
Description: A collaborative learning technique where students ponder a question or problem individually, then discuss their thoughts in pairs or small groups before sharing with the entire class. It fosters active participation, communication skills, and diverse perspectives.
Example: In a Literature in English class, the teacher poses a thought-provoking question about a novel's moral dilemma. Students first reflect individually, then pair up to exchange their opinions, and finally participate in a lively class discussion to explore different viewpoints.

Pedagogy: Questioning Technique (Socratic Approach)
Description: Based on Socratic dialogue, this method stimulates critical thinking by posing thought-provoking questions. It encourages learners to explore ideas, justify their reasoning, and discover knowledge through a process of inquiry.
Example: In an Ethics class, the instructor uses the Socratic approach to lead a discussion on the meaning of justice. By asking a series of probing questions, the students engage in a deeper exploration of ethical principles and societal values.

Pedagogy: Practical Demonstration
Description: A hands-on approach where learners observe real-life applications of theories or skills. Practical demonstrations enhance comprehension, skill acquisition, and problem-solving abilities by bridging theoretical concepts with real-world scenarios.
Example: In a Food and Nutrition class, the instructor demonstrates the proper technique for filleting a fish. Students observe and then practice the skill themselves, learning the practical application of knife skills and culinary precision.

(**Note:** The examples provided in this annexure serve as illustrations of various pedagogies. It is important to understand that these pedagogies are versatile and can be applied across subjects in numerous ways. Feel free to adapt and explore these techniques creatively to enhance learning outcomes in your specific context.)

Acknowledgements

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

We extend our sincere appreciation to Mr. Kashif Hussain, Lead-Specialist in Physics at AKU-EB, for taking subject lead during the entire process of e-marking.

We particularly thank to Mr. Israr ul Haq, Lecturer at MSB Educational institute, Karachi, for evaluating each question's performances, delineating strengths and weaknesses in candidates' responses, and highlighting instructional approaches along with recommendations for better performance.

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

These contributors include:

• Dur Nasab, Associate, Curriculum Development, AKU-EB

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

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

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

• Dr Naveed Yousuf, CEO, AKU-EB