Aga Khan University Examination Board

Notes from E-Marking Centre on HSSC-II Physics Annual Examination 2023

Introduction

This document has been produced for the teachers and candidates of Higher Secondary School Certificate (HSSC) Part II Physics. It contains comments on candidates' responses to the 2023 HSSC Part II Examination, indicating the quality of the responses and highlighting their relative strengths and weaknesses.

E-Marking Notes

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

Teachers and candidates should be aware that examiners may ask questions that address the Students 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

On average, candidates performed well on questions related to electrostatics, current electricity, electromagnetism, electromagnetic induction, alternating current, physics of solids, electronics, dawn of the modern physics and nuclear physics. Whereas low-scoring candidates struggled in question based on atomic spectra.

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

DETAILED COMMENTS

Constructed Response Questions (CRQs)

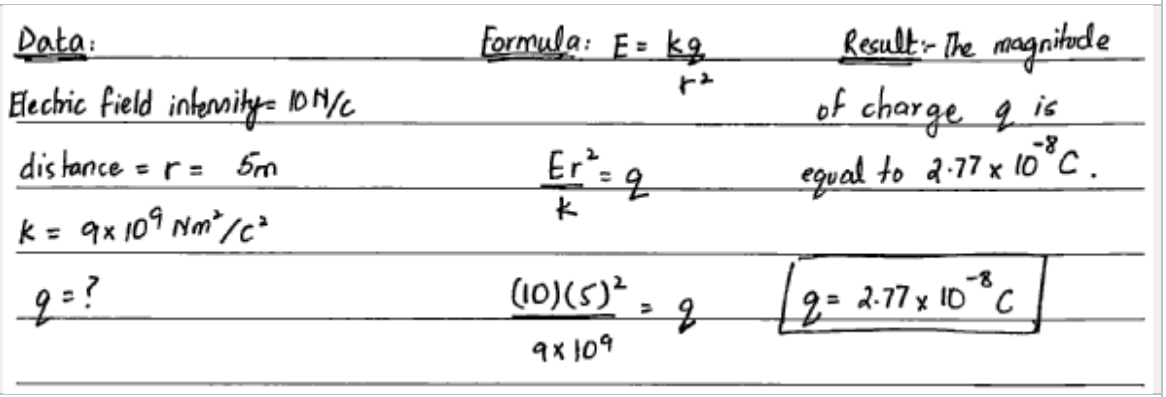
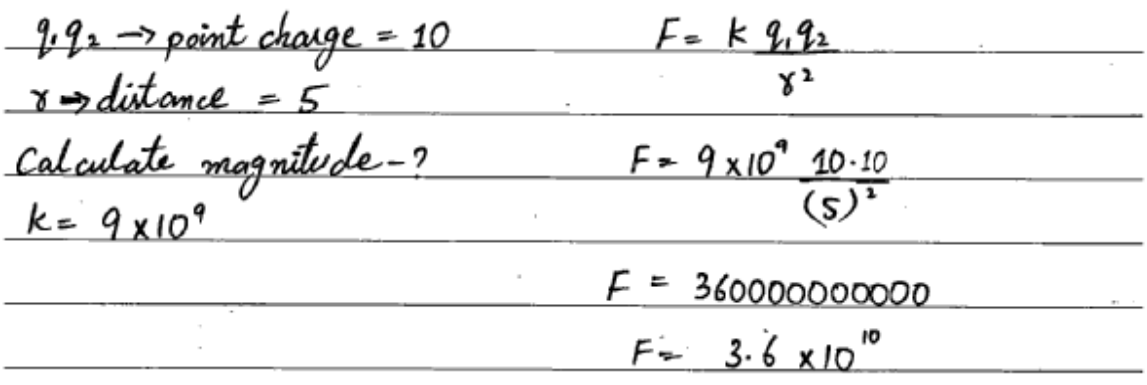
Question No. 1	
Question Text	The electric field intensity of a point charge is 10 N/C at a distance of 5 m. Calculate the magnitude of the point charge. (**Note**: The value of proportionality constant 'k' is 9×10^9 Nm^2/C^2.)
SLO No.	11.3.2
SLO Text	Derive an expression for the magnitude of electric field of a distance or from a point charge "q" and use the expression in solving word problems.
Max Marks	03
Cognitive Level	*A
Checking Hints	1 mark for writing each mathematical step used in the calculation (3 required).
Overall Performance	The overall performance of the cohort in this question was well. Candidates demonstrated a good understanding by accurately identifying the given quantities and recognising the context as related to electric field intensity of a point charge.
Description of Better Responses	The candidates' performance in this question was up to the mark, as they effectively extracted relevant data, identified the topic accurately, and employed the correct formula along with appropriate substitutions, resulting in accurate outcomes presented in proper units. They correctly used the formula $\mathbf{E}=\mathbf{k}\frac{\mathbf{q}}{\mathbf{r}^2}$ substitute and values and got the correct value of magnitude of the point charge. To further improve, students can focus on providing more detailed explanations and step-by-step derivations to showcase their grasp of the topic. Encouraging students to apply their knowledge to real-life scenarios and diverse problem-solving situations can enhance their overall performance in similar questions. Building upon these strengths will undoubtedly lead to even better results in future assessments.
Image of Better Response	
Description of Weaker Responses	In weaker responses, candidates displayed varied answers. While some correctly identified the concept and applied the appropriate formula with accurate data substitution, others displayed misconceptions by using Coulomb's law to find the charge, they substitute the incorrect values in the formula. Several responses demonstrated confusion, with candidates utilising incorrect or irrelevant formulas and making erroneous substitutions. To improve, candidates should focus on understanding fundamental concepts and identifying the right formula for each scenario. Regular practice of problems related to electric field intensity and point charges will enhance their problem-solving skills, leading to more accurate responses in similar situations.

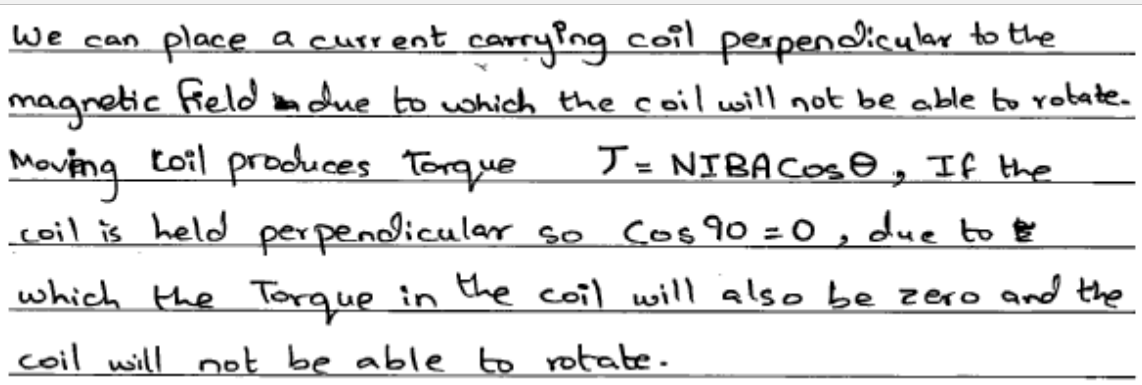
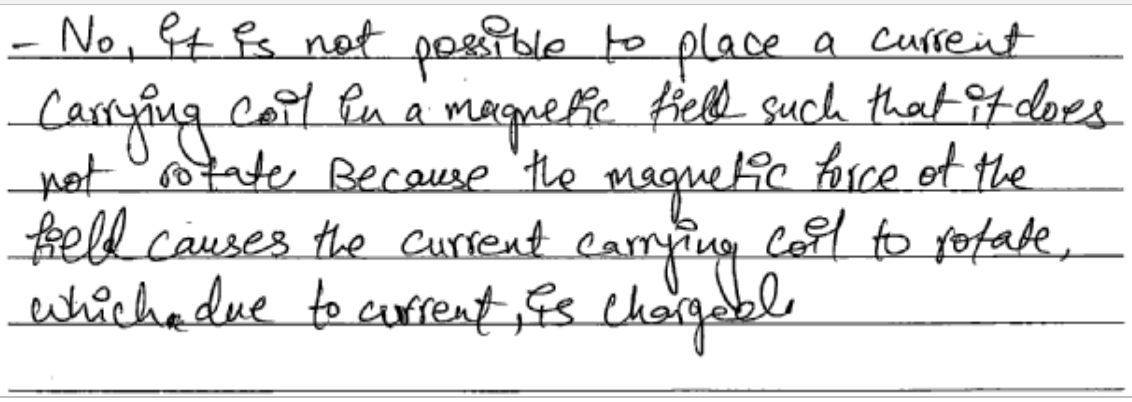
Image of Weaker Response	

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 ** 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: Nil		

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

Question No. 2	
Question Text	Is it possible to place a current carrying coil in a uniform magnetic field in such a manner that the coil will not be able to rotate? Explain your answer with the help of a mathematical equation.
SLO No.	13.4.1
SLO Text	Derive an expression of torque due to a couple acting on a coil and use this expression for solving word problems.
Max Marks	03
Cognitive Level	*U
Checking Hints	1 mark for writing the correct reason along with the correct mathematical equation (3 required).

Overall Performance	The candidates' overall performance in this question was generally satisfactory, demonstrating a sound grasp of magnetic torque. However, some responses lacked clarity in their reasoning and provided weak justifications. They were unable to identify the possibility of placing a current carrying coil in a uniform magnetic field in such a manner that the coil will not be able to rotate and unable to get the torque ($\tau = 0$). To enhance their answers, candidates should strive to provide more in-depth and well-supported explanations, citing relevant concepts and principles from the topic of magnetic torque. Strengthening their understanding of the underlying theory will enable them to offer more robust and accurate responses. Regular practice and application of magnetic torque concepts in various scenarios will further reinforce their comprehension and improve their performance in similar questions.
Description of Better Responses	Better responses demonstrated strong knowledge of the impact of coil orientation on torque, correctly identifying that when the plane of the coil is perpendicular to the magnetic field **B**, the angle **α** becomes **90** degrees. Consequently, they effectively utilised the torque equation **τ = BINA cosα** to deduce that the torque would be zero due to **cos90°=0**. This indicates a strong grasp of magnetic torque principles and its relation to coil orientation in a magnetic field.
Image of Better Response	
Description of Weaker Responses	The responses to the question varied among candidates, with some expressing disagreement and providing illogical explanations related to the working of a galvanometre, using incorrect mathematical formulas. Conversely, some low-scoring candidates agreed with the statement but justified it with irrelevant concepts like magnetic force. A better approach would have been to focus on the principles of electromagnetic induction and the functioning of an ammetre, providing a well-reasoned response. Understanding the correct application of relevant concepts is essential to score higher marks in such questions.
Image of Weaker Response	

Suggestions for improvement (Highlighted part)

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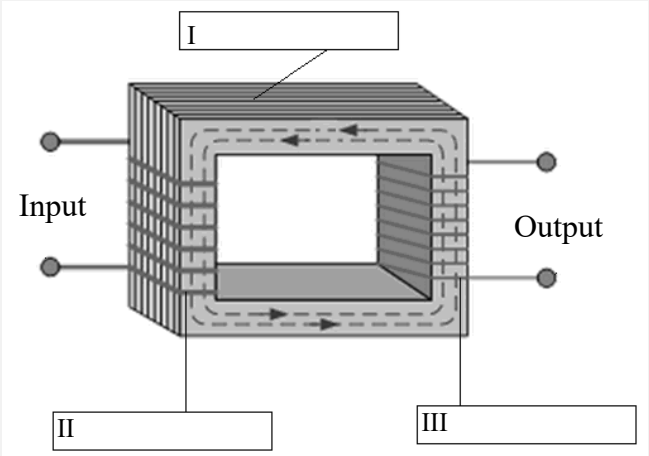
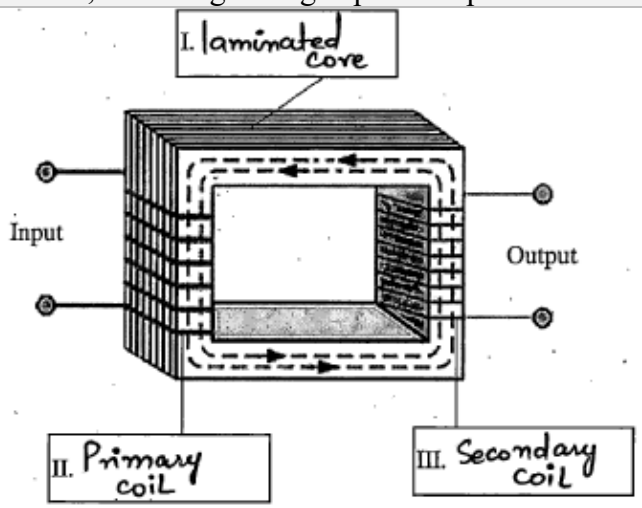
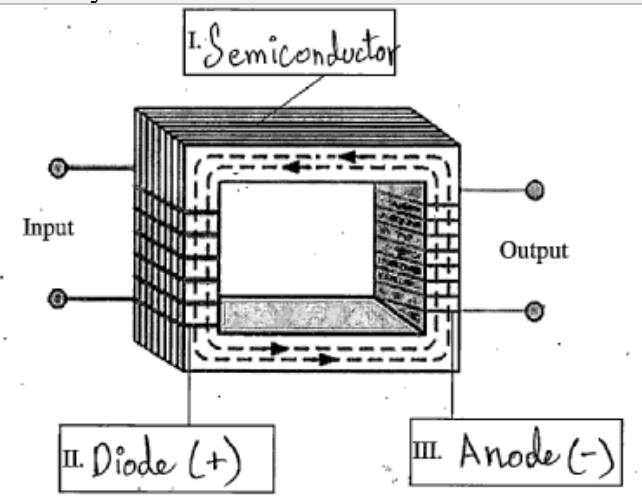
Any Additional Suggestion:
When teaching about a current-carrying coil in a magnetic field, please make sure to spend extra time to ensure that students really understand the topic.

Question No. 3	
Question Text	Label the given diagram of a transformer. 
SLO No.	14.5.1
SLO Text	Describe the principle, construction and working of a transformer.
Max Marks	03
Cognitive Level	U
Checking Hints	1 mark for labelling EACH part of the transformer (3 required).

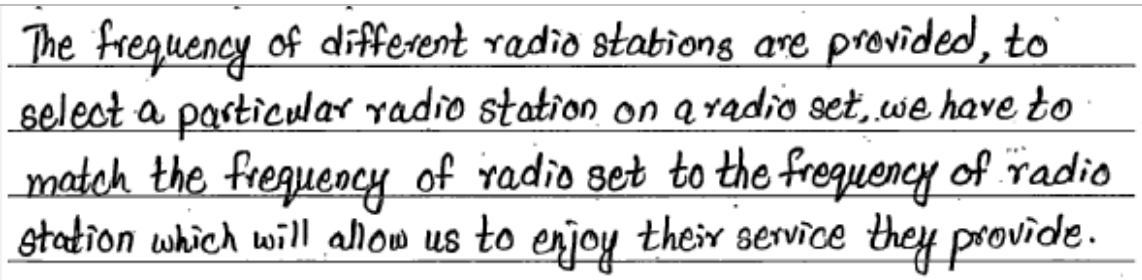
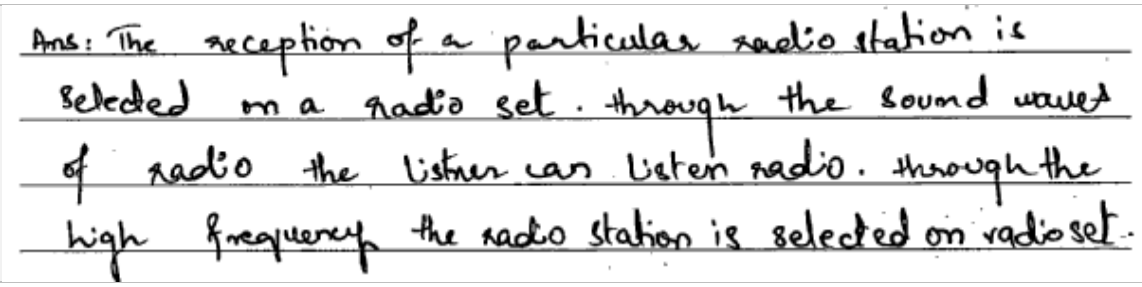
Overall Performance	Majority of the candidates demonstrated a good understanding of the construction of a transformer. They accurately identified its key components, such as primary and secondary coils, laminated iron core, and insulating material. Some responses even highlighted the significance of using a laminated iron core to minimise eddy current losses and enhance efficiency. Overall, the answers reflected a strong grasp of the transformer's construction, indicating a sound knowledge of the topic.
Description of Better Responses	In better responses, many candidates correctly recognised the key components: I. The laminated or sliced soft iron core, crucial for providing a low reluctance path for the magnetic flux, was accurately identified. II. The primary coil or winding, responsible for connecting to the input voltage and inducing a changing magnetic field in the core, was well-recognised. III. The secondary coil or winding, linked to the output voltage and experiencing an induced voltage due to the changing magnetic field, was correctly identified. Candidates' understanding of the transformer's construction and its components was evident, reflecting their grasp of its operation.
Image of Better Response	
Description of Weaker Responses	Candidates provided improper or incorrect identifications, indicating a lack of clarity regarding the transformer's construction. Some of the candidates wrote semiconductor, anode and cathode while identifying the different components of the transformer. To improve their responses, candidates should focus on strengthening their knowledge of transformer components and their roles in the device's functioning. Additionally, paying attention to the wording of the question can help avoid misunderstandings and enhance accuracy in future assessments.
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 ** 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 are encouraged to incorporate visual diagrams and animations of electrical instruments utilised in both alternating and direct current circuits during their classroom teaching.

Question No. 4	
Question Text	Explain how the reception of a particular radio station is selected on a radio set.
SLO No.	15.5.2
SLO Text	Describe production, transmission and receptions of electromagnetic (EM) waves.
Max Marks	02
Cognitive Level	U
Checking Hints	1 mark for each statement mentioned in the explanation (Any 2 required).
Overall Performance	Overall, the cohort demonstrated a thorough understanding of electromagnetic wave's transmission and reception. Their knowledge in this area is impressive.
Description of Better Responses	The cohort effectively explained the function of a variable capacitor in creating resonance for specific frequencies to facilitate tuning to respective channels. Their explanations demonstrate clarity and precision, highlighting a solid grasp of the subject matter. They wrote about a particular radio station can be selected on a radio set by tunning it, radio programmes of different stations are present in the form of electromagnetic waves of different frequencies/ amplitudes, choosing the programme of our interest by adjusting the frequency or amplitude of our receiving set equal to the frequency or amplitude of the radio station of our choice, can be done by rotating the tuning knob to varying capacitance and thus the frequency or amplitude of the receiving set and current of this radio signal becomes maximum and so, the signal is amplified and becomes detectable.

Image of Better Response	 The frequency of different radio stations are provided, to select a particular radio station on a radio set, we have to match the frequency of radio set to the frequency of radio station which will allow us to enjoy their service they provide.
Description of Weaker Responses	It is essential to address the concept of frequency matching between the radio set and the transmitted signal, which is currently missing in the weaker responses. Encouraging candidates to include this vital step in their explanations will enhance their comprehension of radio communication. Emphasising the significance of frequency alignment will contribute to a more comprehensive analysis of radio-related concepts. By incorporating this aspect, they can further refine their responses and excel in their understanding of radio communication principles.
Image of Weaker Response	 Ans: The reception of a particular radio station is selected on a radio set. through the sound waves of radio the listner can listen radio. through the high frequency the radio station is selected on radio set.

Suggestions for improvement (Highlighted part)

How to Approach SLO	Pedagogy** Used for that SLO	Assessment Strategies
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Any Additional Suggestion:
To help students become even better at this subject, consider teaching them more advanced topics like wave propagation and modulation techniques. Try hands-on experiments to make learning more practical. Also, remember to praise their progress to keep them excited about electromagnetic phenomena.

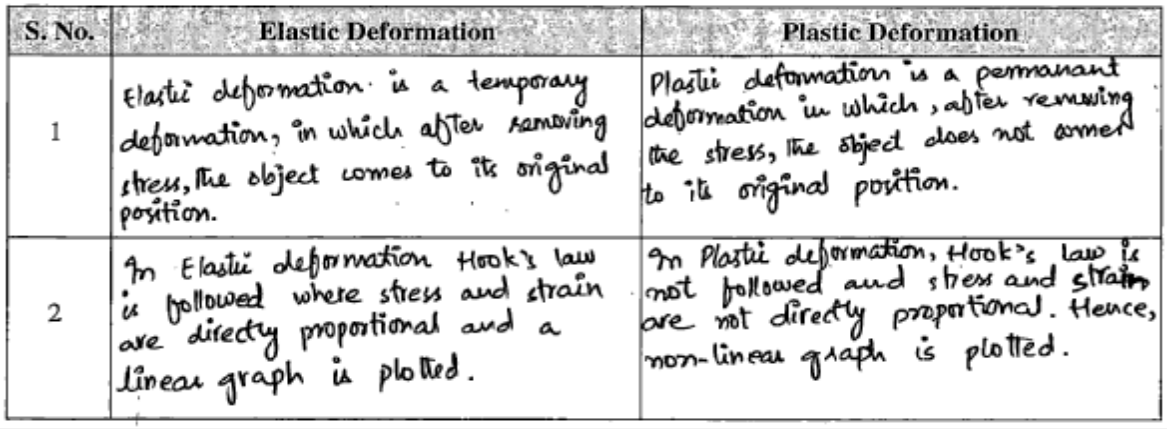
<table>
<tr><th colspan="2">Question No. 5</th></tr>
<tr><td>Question Text</td><td>Differentiate between elastic and plastic deformations in solids.</td></tr>
<tr><td>SLO No.</td><td>Differentiate between elastic and plastic deformations in solids in any TWO points.</td></tr>
<tr><td>SLO Text</td><td>16.2.1</td></tr>
<tr><td>Max Marks</td><td>02</td></tr>
<tr><td>Cognitive Level</td><td>U</td></tr>
<tr><td>Checking Hints</td><td>1 mark for each difference (Any 2 required).</td></tr>
<tr><td>Overall Performance</td><td>The cohort demonstrated a great effort in addressing the question. The majority of responses thoughtfully outline the distinctions between elastic and plastic deformation in solids. A notable understanding of Hooke’s law is evident, underscored by accurate articulation of its mathematical formulations and graphical representations. To elevate their performance, candidates might consider further exploring practical applications of these principles, exemplifying real-world contexts where each type of deformation holds relevance. This approach would showcase a comprehensive mastery of material behaviour, enhancing their capacity for theoretical application.</td></tr>
<tr><td>Description of Better Responses</td><td>The cohort adeptly distinguished between elastic and plastic deformation, demonstrating precision in their explanations. Some of the differences written by candidates are as follows. Elastic deformation is a temporary deformation under the action of external loading whereas plastic deformation is the permanent deformation. Once the external load is removed from an elastically deformed body, it regains its original shape whereas when a body is plastically deformed, it retains its deformed shape even after the removal of external load. In elastic deformation, atoms of the material are displaced temporarily from their original lattice site. They return to their original position after the removal of external load whereas in plastic deformation, atoms of the solid are displaced permanently from their original lattice site. They don’t return to the original position even after the removal of external load. Amount of elastic deformation is very small whereas amount of plastic deformation is quite large. External force required for elastic deformation of solid is quite small whereas force required for plastic deformation is also higher.</td></tr>
<tr><td>Image of Better Response</td><td> 
<table>
<tr><th>S. No.</th><th>Elastic Deformation</th><th>Plastic Deformation</th></tr>
<tr><td>1</td><td>Elastic deformation is a temporary deformation, in which after removing stress, the object comes to its original position.</td><td>Plastic deformation is a permanent deformation in which, after removing the stress, the object does not come to its original position.</td></tr>
<tr><td>2</td><td>In Elastic deformation Hook's law is followed where stress and strain are directly proportional and a linear graph is plotted.</td><td>In Plastic deformation, Hook's law is not followed and stress and strain are not directly proportional. Hence, non-linear graph is plotted.</td></tr>
</table></td></tr>
<tr><td>Description of Weaker Responses</td><td>The cohort exhibits challenges in effectively differentiating between elastic and plastic deformation. Some candidates demonstrated attempts, albeit with inaccuracies. Some of the candidates wrote about transformation of energy, time required for deformation of matter, and state of matter involved in these types of deformations. Encouraging a focus on fundamental principles, such as Hooke’s law and the yielding point, could aid comprehension. Practical scenarios illustrating each deformation type could enhance understanding. Constructive feedback and targeted practice will guide candidates towards accurate differentiation, nurturing improved performance. Acknowledging their efforts while gently guiding them towards precision will enrich their overall learning journey.</td></tr>
</table>

Image of Weaker Response

S. No.	Elastic Deformation	Plastic Deformation
1	Elastic Defoomation needs more energy than Plastic to deform Elastic	Plastic Defoomation needs Less energy than Elastic to deform Plastic.
2	Elastic Defoomation takes more time than Plastic Defoomation	Plastic Deformation takes Less time than Elastic Deformation.

Suggestions for improvement (Highlighted part)

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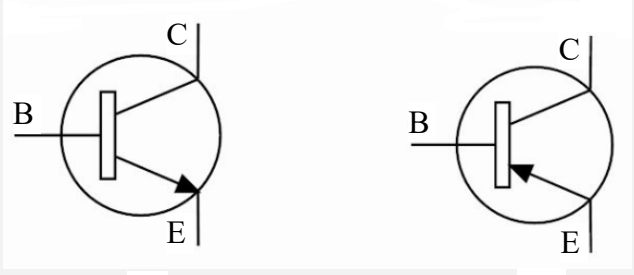
Any Additional Suggestion:
Teachers are encouraged to explain variances among multiple quantities discussed within a single topic.

Question No. 6	
Question Text	a. Identify the following transistors.  **(I)** **(II)** b. Write any TWO differences between the transistors identified in part (a).
SLO No.	17.2.11
SLO Text	Distinguish between PNP and NPN transistor.

Max Marks	03
Cognitive Level	U
Checking Hints	1 mark for correctly identifying both the transistor. 1 mark for writing the correct difference (Any 2 required).
Overall Performance	Overall, the cohort's attempt was good, yet an area requires refinement. Some candidates encountered difficulty in accurately distinguishing elements within part 'a'. They were unable to correctly identified the transistors and wrote forward and reverse biased transistors and differentiate them.
Description of Better Responses	The cohort accurately identified the transistor type in part 'a' and demonstrated an understanding of the arrow's significance on the emitter terminal. Clear differentiation between NPN and PNP transistors was provided. Some of the differences written by candidates are as in NPN transistor base in p-type whereas in PNP transistor base in n-type. In n-p-n transistor, p-layer separates two n-type layers whereas in p-n-p transistor, n-layer separates two p-type layers. The flow of current in n-p-n transistor is from collector terminal to emitter whereas the flow of current in p-n-p transistor is from emitter terminal to collector. NPN transistor will activate when majority charge carriers like electrons enter the base terminal whereas PNP transistor will activate when majority charge carriers like holes enter the base terminal. In NPN transistor, collector-base junction is reverse biased whereas in PNP transistor, emitter-base junction is forward biased.
Image of Better Response	a. (I) NPN Transistor (II) PNP Transistor b.

S. No.	I	II
1	The base is made ~~of~~ by doping with trivalent impurity that is base is p type semiconductor.	Base is made by doping with pentavalent impurity that is base # is n type semiconductor.
2	Majority charge carriers are electrons.	Majority charge carriers are holes.

Description of Weaker Responses	Weaker responses revealed instances of incorrect component identification, some responses demonstrated a deviation from the specified command words, resulting in inaccuracies in differentiation. Some of the candidates wrote about forward and reverse biased transistors and mentioned their differences. Reinforcing the significance of meticulous reading and adherence to question prompts is recommended. Encouraging candidates to closely examine components and consider their distinguishing attributes can prevent such errors. Constructive guidance, coupled with focused practice, will refine analytical acumen, fostering more accurate and contextually precise responses in the future.
Image of Weaker Response	a. (I) Forwaad biased transistor. (II) Reversed biased transistor. b.

S. No.	I	II
1	In forwaad biased transistor, the positive terminal of external battery is connected to P-junction of transistor.	In revered biased transistor, the positive terminal of battiy is connected to n-junction.
2	The negative terminal of battery is connected to n-junction.	The negative terminal of battiry is connected to P-junction.

Suggestions for improvement (Highlighted part)

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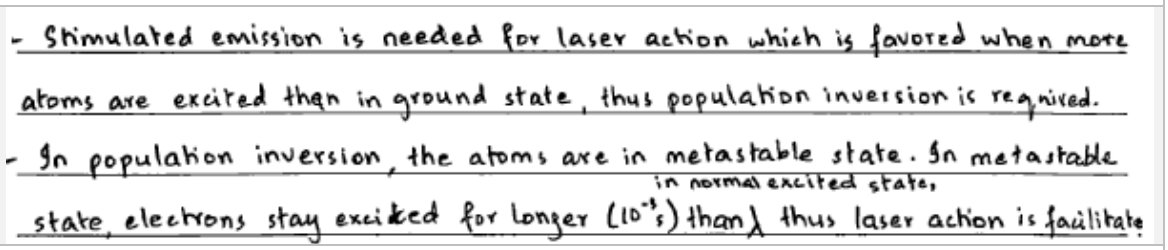
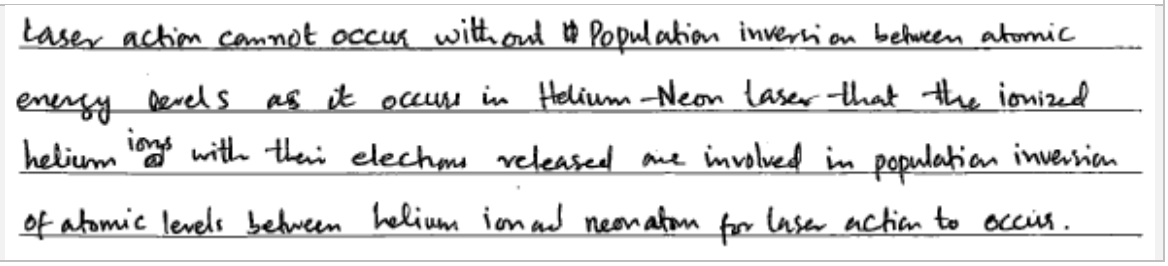
Any Additional Suggestion:
Nil

Question No. 7	
Question Text	Explain, in any TWO points, why laser action cannot occur without population inversion between atomic energy levels.
SLO No.	19.5.1
SLO Text	Describe the following terms: a. spontaneous emission, b. stimulated emission, c. meta-stable state, d. population inversion, e. laser action.
Max Marks	02
Cognitive Level	U
Checking Hints	1 mark for writing each point (2 required).
Overall Performance	The cohort generally addressed the concept of population inversion yet falls short in providing a precise rationale for its significance in laser action. Some of the candidates mixed the explanations of laser action and population inversion and illogical provide the reason that laser action cannot be possible without population inversion between atomic energy levels.
Description of Better Responses	Few of the candidates demonstrated proficiency in presenting a comprehensive definition, including meta-stable states, and recognising the requisite population inversion for stimulated emission, a fundamental for laser operation. To deepen their responses, candidates could explore into how this inversion produces an excess of excited atoms, fostering coherent photon emission. Encouraging practical applications or examples illustrating these concepts would enrich their understanding. Acknowledging their skilled definitions and insightful explanations while underscoring broader implications will foster a more comprehensive grasp of laser mechanisms, nurturing their analytical acuity.
Image of Better Response	
Description of Weaker Responses	The cohort primarily focused on defining population inversion or inadequately addressing its significance, indicating potential gaps in comprehending laser action. Additionally, several responses lacked a thorough portrayal of the roles played by meta-stable states, population inversion, and stimulated emission in laser operation. Encouraging candidates to delve deeper, particularly elucidating how these components contribute to light amplification and coherence, would enhance their understanding. Targeted practice and guidance can effectively address these conceptual challenges, fostering a more robust grasp of laser mechanics among the cohort.
Image of Weaker Response	

Suggestions for improvement (Highlighted part)

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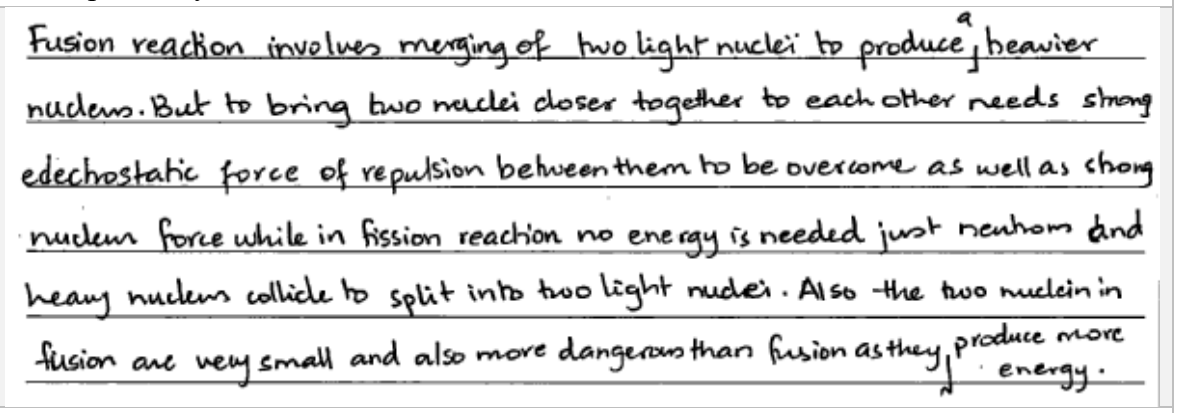
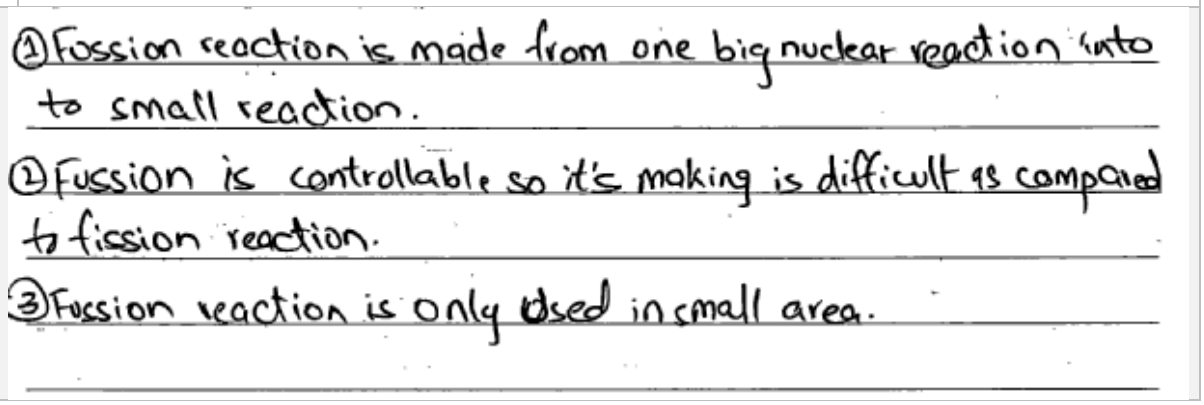
Any Additional Suggestion:

- Being an important topic in physics and futuristic field of research for pursuing higher degree in the field of physics, subject teachers are advised to deliver their teaching/ instructions from the basic to higher concept of atomic spectra.
- Encouragingly, candidates could delve deeper into the pivotal role of population inversion in facilitating stimulated emission a fundamental principle underpinning laser operation. By explaining how this condition amplifies photons and stimulates coherent light emission, candidates would enhance their understanding. Strengthening the direct correlation between population inversion and laser action will enrich their responses, offering a more comprehensive and precise analysis of this crucial phenomenon.

Question No. 8	
Question Text	Explain, in THREE points, why it is more difficult to start a fusion reaction than a fission reaction.
SLO No.	20.8.1
SLO Text	Differentiate between nuclear fission and fusion.
Max Marks	03
Cognitive Level	U
Checking Hints	1 mark for each statement provided in the explanation (Any 3 required).
Overall Performance	The cohort effectively tackled the question, demonstrating strong knowledge of fission and fusion reactions. Responses showcased a well-informed understanding of these processes. Overall, the candidates' informed responses underscore their robust foundational grasp of the subject.

Description of Better Responses	Most of the high-scoring candidates demonstrated their responses by offering concise definitions of fission and fusion reactions. Additionally, they recognised the challenge inherent in fusion reactions, slowing from the influential electrostatic force of repulsion, necessitating significant energy input. Some of the candidates wrote about the fusion reaction releases much more energy per unit mass than the fission reaction, it is very difficult to produce fusion reaction and this difficulty is due to the fact that when two positively charged nuclei are brought closer and closer and then fused together, work has to be done against the electrostatic force of repulsion, required a great deal of energy and it is easy to produce fission reaction because neutron is uncharged particle and it can wander about the nucleus, without experiencing any electrostatic force of repulsion, before it is captured by the nucleus.
Image of Better Response	 Fusion reaction involves merging of two light nuclei to produce a heavier nucleus. But to bring two nuclei closer together to each other needs strong edechostatic force of repulsion between them to be overcome as well as strong nucleus force while in fission reaction no energy is needed just neutrons and heavy nucleus collide to split into two light nuclei. Also the two nuclein in fusion are very small and also more dangerous than fusion as they produce more energy.
Description of Weaker Responses	The cohort has largely presented statements without thorough explanations, often failing to justify them. They wrote the definitions of fission and fusion their characteristics and their physical and chemical properties which were not demanded in the questions. Encouraging candidates to explore into involved particle interactions and chain reaction dynamics will deepen understanding. Acknowledging their efforts and guiding them towards more comprehensive justifications will foster improved analytical skills in forthcoming responses.
Image of Weaker Response	 ①Fossion reaction is made from one big nuclear reaction into to small reaction. ②Fussion is controllable so it's making is difficult as compared to fission reaction. ③Fussion reaction is only used in small area.

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:
Teachers are encourage to recognize their students for their current skills and inspire them to explore real-life examples. This will help them understand how these nuclear reactions are important in different areas of science and technology.

Extended Response Questions (ERQs)

These questions offered a choice between part **a** and **b**.

Question No. 9a

Question Text	Given are three combinations of colour bands for three different resistors. i. brown-blue-white ii. black-black-violet iii. grey-green-brown **Colour** / **Code**: Black 0, Brown 1, Red 2, Orange 3, Yellow 4, Green 5, Blue 6, Violet 7, Grey 8, White 9 Calculate the values carbon resistance of all the given resistors and classify them as the highest, the lowest and an invalid resistor.
SLO No.	12.3.6
SLO Text	Calculate the value of carbon resistance by using colour code.
Max Marks	07
Cognitive Level	A
Checking Hints	1 mark for finding the correct code multiplier of each resistor (3 required). 1 mark for finding the correct answer of each resistor (3 required). 1 mark for the correct classification.

Overall Performance

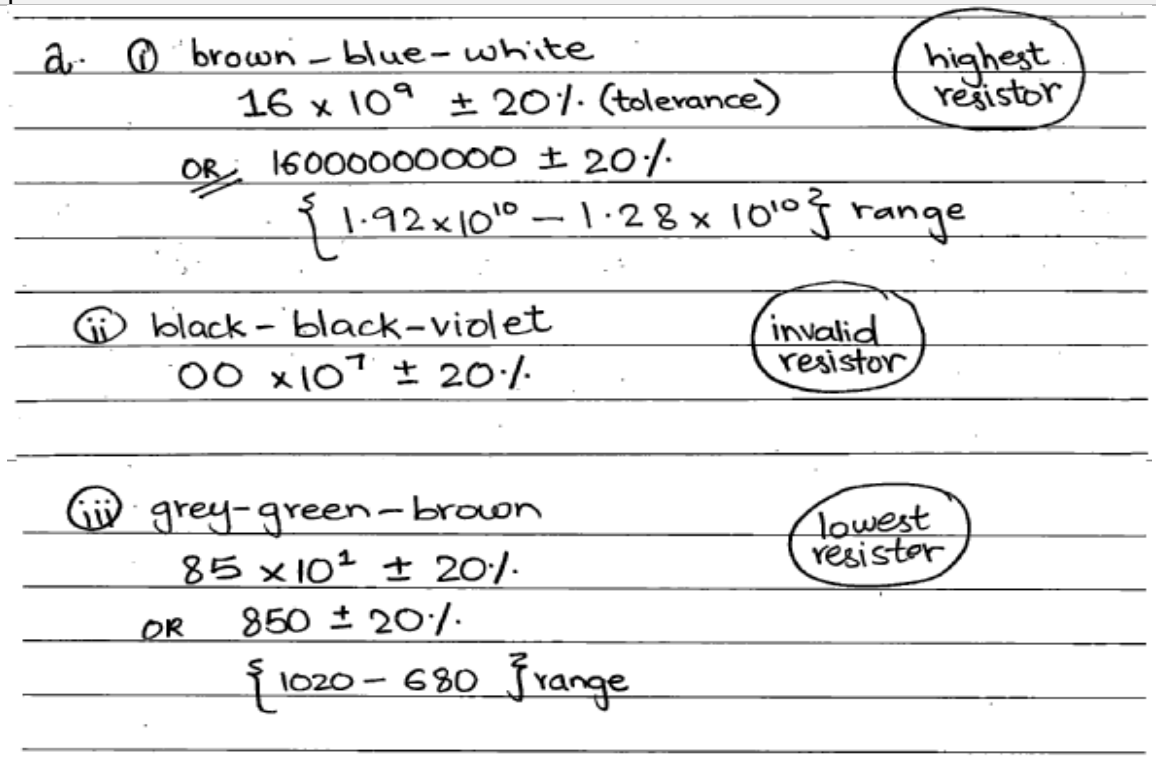
Majority of the candidates attempted this question and demonstrated proficient comprehension of decoding carbon resistance values through the colour code, including correct identification of the 20% tolerance, despite the absence of the fourth band. Some of the candidates made the table and calculated the value of carbon resistance and classified them as highest and lowest and invalid resistors.

brown-blue-white (Brown Code. Blue Code) × White Code Multiplier (16) × 1000000000 $1.6 \times 10^{10}\ \Omega$	black-black-violet (Black Code. Black Code) × Violet Code Multiplier (00) × 10000000 0.0 Ω	grey-green-brown (Grey Code. Green Code) × Brown Code Multiplier (85) × 10 $8.5 \times 10^{2}\ \Omega$
Highest	Invalid	Lowest

Description of Better Responses

Better responses accurately grasped the significance of the first, second, third, and fourth colour bands in carbon resistors. Candidates proficiently decoded resistance values based on colour bands, demonstrating accurate classification into highest (brown-blue-white), lowest (grey-green-brown), and invalid (black-black-violet) categories. For enriched responses, candidates could delve into the practical implications of these classifications in circuitry and applications. Acknowledging their precise decoding and adept classification while encouraging deeper insights will foster a more comprehensive understanding of these pivotal resistor attributes.

Image of Better Response

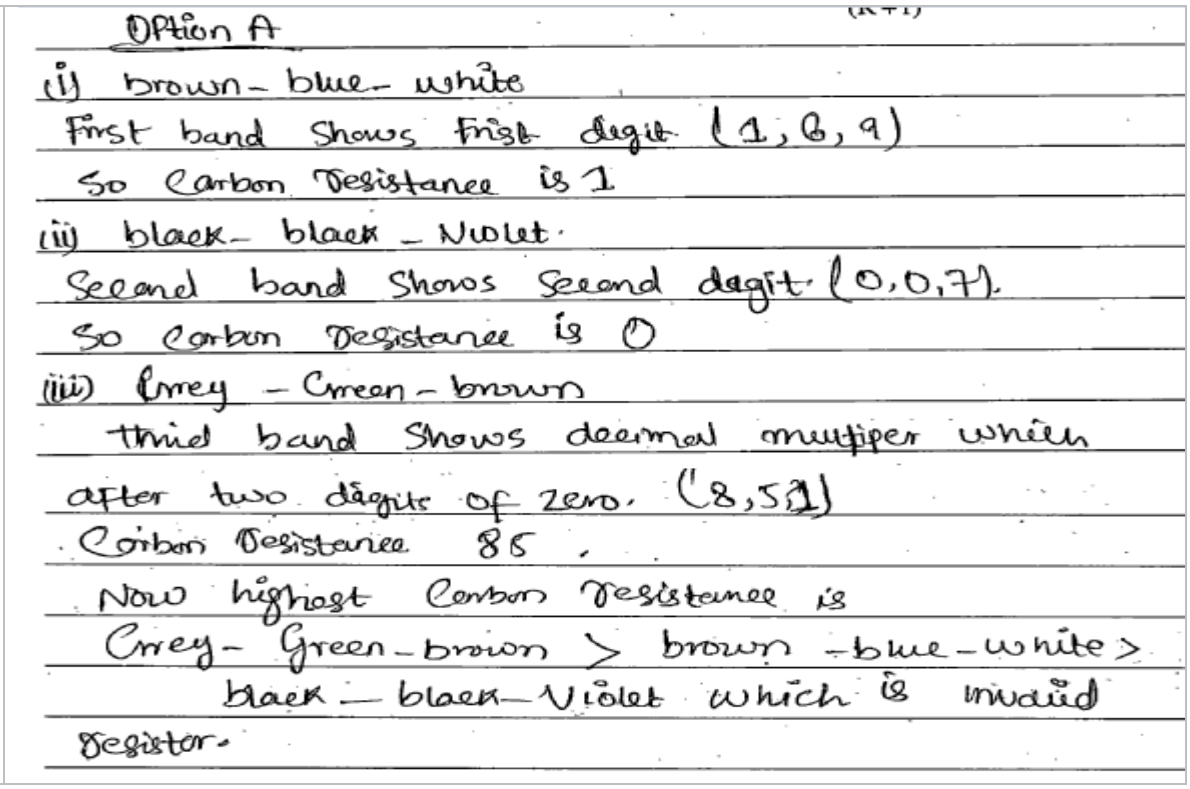


Description of Weaker Responses

Certain candidates with lower scores encountered challenges in accurate decoding due to limited familiarity with the meanings associated with the first, second, third, and fourth colour bands resulting in misclassifications. Some of the candidates misinterpret the demand of the question and wrote about the replication of the information given in the question like as

Colour	Black	Brown	Red	Orange	Yellow	Green	Blue	Violet	Grey	White
Code	0	1	2	3	4	5	6	7	8	9

Guiding these candidates to acquaint themselves with the colour code and its corresponding values can address this concern. Emphasising the significance of resistor band interpretation and encouraging correct decoding will likely enhance their classification accuracy. Constructive feedback, coupled with focused practice, will augment their foundational understanding, and promote more precise classifications in analogous scenarios.

Image of Weaker Response	

Option A

(i) brown – blue – white

First band shows first digit (1, 6, 9)

So carbon resistance is 1

(ii) black – black – Violet

Second band shows second digit (0, 0, 7).

So carbon resistance is 0

(iii) Grey – Green – brown

third band shows decimal multiper which after two digits of zero. (8, 5, 1)

Carbon Resistance 85 .

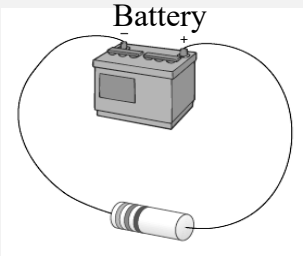
Now highest Carbon resistance is

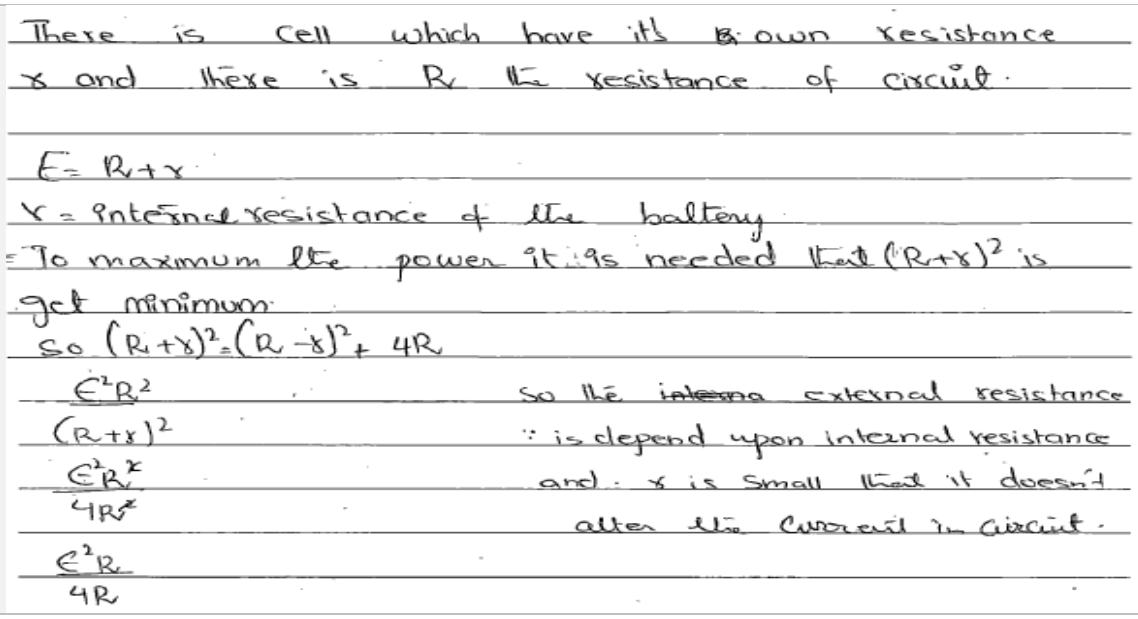
Grey – Green – brown > brown – blue – white > black – black – Violet which is invalid resistor.

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:
Nil

Question No. 9b	
Question Text	The given diagram shows a source of e.m.f. (ε) of internal resistance (r), connected to an external resistor of resistance (R).  Show that the power (P) delivered to the load resistance (R) is $P = \frac{\varepsilon^2 R}{(R+r)^2}$
SLO No.	12.4.6
SLO Text	Calculate the power dissipation due to the internal resistance of a circuit.
Max Marks	07
Cognitive Level	A
Checking Hints	1 mark for each mathematical step used in the derivation (7 required).
Overall Performance	Candidates effectively addressed this part of the question, successfully deriving the load power relation. Responses revealed a robust understanding of Ohm's law, internal resistance, resistance combinations, and electrical power. To further enhance their insights, candidates could explore practical applications of this power relation, illustrating real-world contexts where these concepts are pivotal.
Description of Better Responses	High-scoring candidates accurately discerned the circuit as a series combination of internal resistance and a load resistor. They proficiently apply Kirchhoff's voltage law or Ohm's law, alongside series resistance principles, to establish a current relation, subsequently utilised to formulate the power relation. Some of the candidates correctly wrote the important steps of the derivation as P = W/t, P = QV/t, P = I V and $P = \frac{\varepsilon^2 R}{(R+r)^2}$.
Image of Better Response	$P = V \times I$ — P is Power $P = (I \times R) \times I$ — R is Resistance $P = I^2 R$ — (1) — I is current $\varepsilon = IR + Ir$ — ε = E.m.f $\varepsilon = I(R+r)$ — R = External Resistance $I = \frac{\varepsilon}{R+r}$ — (2) — r = Internal Resistance $P = I^2 R$ (substituting values) $P = \left(\frac{\varepsilon}{R+r}\right)^2 R$ $P = \frac{\varepsilon^2 R}{(R+r)^2}$ or $P = \frac{\varepsilon^2 R}{(R-r)^2 + 4Rr}$ $(R+r)^2$: $R^2 + 2Rr + r^2 + 2Rr - 2Rr$ $R^2 - 2Rr + r^2 + 4Rr$ $(R-r)^2 + 4Rr$ P =

Description of Weaker Responses	Some of the candidates encountered challenges in meeting the question's demand, often focusing on explaining power dissipation via internal resistance rather than conducting the derivation. This suggests a potential weaker grasp of circuit analysis. Furthermore, candidates faced difficulties in determining circuit current and lacked the necessary steps for deriving the relation. Encouraging a revisit to fundamental circuit analysis principles, emphasising current determination and systematic derivation steps, can enhance their proficiency. Tailored practice and guided problem-solving will likely address these concerns, nurturing a more comprehensive command of circuit analysis among the candidates.
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 ** 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:
Nil

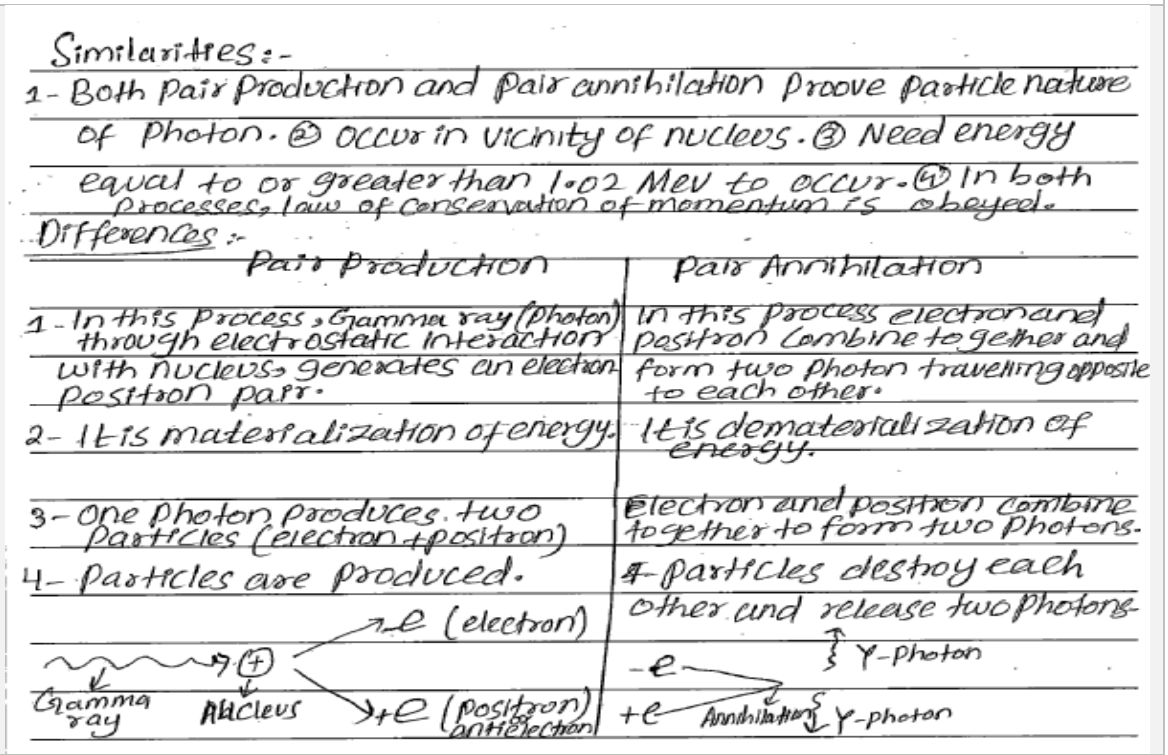
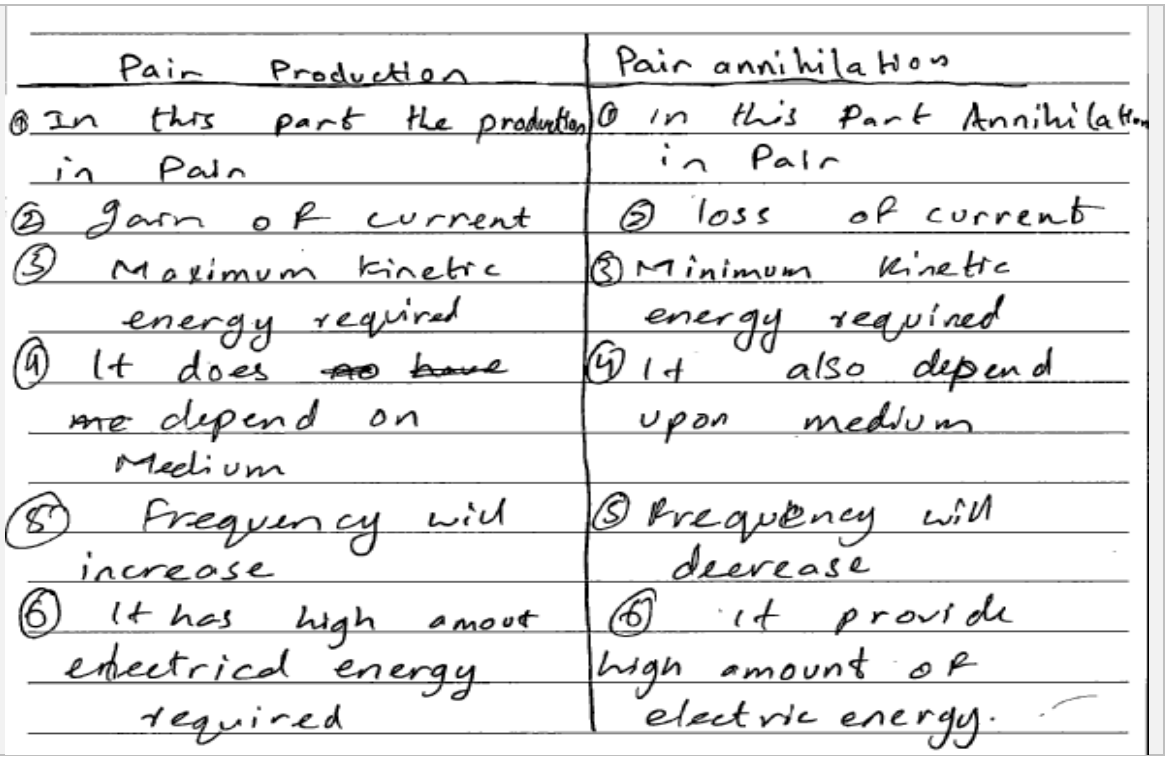
Question No. 10a	
Question Text	Compare pair production and pair annihilation in SEVEN points.
SLO No.	18.4.2
SLO Text	Compare the phenomenon of pair production and pair annihilation.
Max Marks	07
Cognitive Level	U
Checking Hints	1 mark for each statement related to the comparison of both (7 required).
Overall Performance	Majority of the candidates attempted this part of the question and accurately tackled the question, evidencing a strong grasp of pair production and mass annihilation phenomena. Responses underscored candidates' informed understanding. Some of the candidates wrote about pair production is a process in which the electron and positron are formed by an incident photon on the nucleus, pair production takes place when a very high energy photon such as that of γ-rays interacts with matter, during this process photon energy is changed into an electron- position pair. Whereas in pair annihilation, they wrote about that is the converse of pair production, when a particle and antiparticle come together, they annihilate each other and only energy is left, this energy can also be used to create other particles and particles can be created by converting the energy into photon to a particle-antiparticle.
Description of Better Response	Better responses demonstrated a strong understanding of pair production and mass annihilation phenomena. Candidates proficiently compared these processes, encompassing accurate definitions, mathematical equations, diagrams, and insightful analysis through the lens of wave-particle duality.
Image of Better Response	
Description of Weaker Response	Weaker responses indicated that candidates displayed varied answers, with instances of inaccurate definitions, incomplete statements, and tangential explanations unrelated to the specified phenomena. Some of the candidates wrote about electric current, kinetic and potential energies, electrical energy and frequencies of particles. Encouraging precision and relevance in their responses is advised. Providing illustrative correct examples and stressing the importance of contextual accuracy can guide candidates towards more precise and pertinent answers. Constructive feedback, coupled with targeted practice, will refine their ability to align explanations with the specific phenomena in focus, elevating the overall quality of their responses.

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 ** 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 enhance their insights, candidates might explore practical applications or theoretical implications of these phenomena, offering real-world contexts where they are pivotal. Acknowledging their well-informed responses while encouraging exploration of practical scenarios will nurture a deeper, more comprehensive grasp of these foundational concepts, reflecting the cohort's strong foundation in this domain.

Question No. 10b	
Question Text	i. According to the photoelectric effect, does the number of ejected electrons depend upon the brightness (intensity) of incident light or upon the frequency of incident photons? Justify your answer with TWO valid reasons. ii. Two different metals are used in photoelectric effect. Will their threshold frequency be the same? Give a statement to support your answer. iii. Does the intensity of incident light affect the maximum kinetic energy of the photoelectrons? Justify your answer.
SLO No.	18.3.1
SLO Text	Describe photoelectric effect.
Max Marks	07
Cognitive Level	U
Checking Hints	i. 1 mark for writing the correct identification. 1 mark for writing each correct reason (2 required). ii. 1 mark for writing 'NO'. 1 mark for writing the correct reason. iii. 1 mark for each point (2 required).
Overall Performance	Overall, the cohort accurately addressed the question, displaying a clear comprehension of the photoelectric effect. Responses underscored an accurate understanding of the phenomenon.
Description of Better Responses	Better responses accurately discussed the necessity of threshold frequency in the photoelectric effect. Additionally, candidates recognised the correlation between photo current and incident light intensity, attributing it to increased photon count and subsequent rise in photoelectron emission. They also differentiated threshold frequencies among various metals due to distinct work functions. Lastly, candidates aptly depicted frequency's influence via Einstein's photoelectric equation. Some of the candidates wrote in the first part of the question as 'Yes' brightness of a beam of light depends upon the number of ejecting photons from the metal surface and not upon the frequency of photons the brightness increases with the increase in the intensity of light fall on the metal surface and this increase in the intensity is due to the increase in ejecting number of photons from a metal surface. In the second part, they correctly identified as 'No' the threshold frequency is a characteristic of metals, so the threshold frequency is different for different materials. And in the third part, they identified as 'No' and mentioned that the maximum kinetic energy of the photoelectrons is $E_{max} = ½ mv^2 = V_o e$.

Image of Better Response	i- Number of ejected electrons depends upon intensity of ~~i~~incident light. • A single photon is occupied by a single electron, so more intensity means more photons which will eject more electrons. • If $I_2 > I_1$ so I_2 will emit more electrons ~~seen~~ than I_1 even at same stopping potential. ii- NO, their threshold frequency will be different. Threshold frequency (f_0) is the minimum frequency at which a metal ejects electrons, and it ~~varies~~ varies from metal to metal. iii- No, the intensity of incident ~~photons~~ light does not affect the maximum kinetic energy of photoelectrons because the maxium K.E of electrons depends upon the frequency. $E \propto f$ so, as the frequency increases, kinetic energy of photo-electrons increases.
Description of Weaker Responses	In weaker responses, few candidates displayed misconceptions or mishandled the question, resulting in inaccurate explanations. Erroneous or insufficient justifications were given for their statements, often accompanied by imprecise graphical representations. They wrote about the concept of different metals helping in ejecting electrons, intensity and frequencies kinetic and potential energies of the ejecting electrons. Emphasising meticulous comprehension of the question and its nuances before constructing responses is pivotal. Highlighting the significance of accurate reasoning and providing exemplars of proper explanations and graphical depictions will steer candidates towards more precise and pertinent answers. Constructive feedback, coupled with targeted practice, can rectify these issues, enhancing the overall quality of responses across the cohort.
Image of Weaker Response	(i) Number of ejected electron depend upon brightness (intensity) of incident light or upon the the frequency. Because as we know that electron emitted from metal under photoelectric effect need light. When intencity of light increase than electron are emitted and for more intensity more frequenee is need beceuse when frequence is increase than energy is also increase. Frequence ∝ Energy and inversly propotional to (λ) wavelength. As a result when energy increase intensity of light increase and Number of ejected electron also increase. (ii) The both metals cased in photoelectric effect have same threshold frequenee because both metels receive same amount of light, and emitting electron as that they both have same frequence as well because of same amout of light both metals have same frequence. (iii) Yes! intensity of incident light affect the maximum K.E of photoelectrons. Because when intensity of light incident on metal than tempeature of the metal increase as a result K.E blw photoelectron increase.

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:
Encouragingly, candidates not only grasped the effect but also recognised classical physics' inadequacies in explaining it, highlighting the imperative for a quantum explanation. To enhance their responses, candidates could explore practical applications or implications of the photoelectric effect. Acknowledging their adept understanding and insightful recognition of classical physics' limitations, while fostering exploration of practical contexts, will nurture a more comprehensive grasp of this pivotal concept.

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 HSSC-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 Saib Ahmed, Principal Marker, Government Degree Science College, Orangi Town, 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:

- Dr Sumera Anjum, Lead Specialist, Curriculum and Examination Development, AKU-EB
- Rabia Nisar, Specialist, Assessment, AKU-EB
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- Ali Aslam Bijani, Manager, Teacher Support, AKU-EB
- Dr Shehzad Jeeva, CEO, AKU-EB