THE UNITED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

CANDIDATES' ITEM RESPONSE ANALYSIS REPORT ON THE CERTIFICATE OF SECONDAR EDUCATION EXAMINATION (CSEE) 2023

AUTOMOTIVE ENGINEERING

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087 AUTOMOTIVE ENGINEERING

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FOREWORD

This report presents Candidates' Items Response Analysis (CIRA) on Form Four National Examination in Automotive Engineering subject, which was conducted in November 2023. This report aims to provide feedback to all educational stakeholders on the factors that contributed to the candidates' performance in Automotive Engineering subject.

The Certificate of Secondary Education Examination (CSEE) is a summative evaluation, which intends to monitor students' learning and to provide feedback that teachers, students and other educational stakeholders can use to improve teaching and learning processes. This analysis shows justification for the candidates' performance in the Automotive Engineering subject. It reveals that, the candidates had good performance in the topic of Mechanical Engineering Jobs and Occupations, Tools and Equipment, Engine Systems, Maintenance Practice, Automotive Systems II (Braking System) and Automobile Engine Technology. Furthermore, the candidates had average performance in the topics of Automotive Systems I (The Clutch), Refrigeration and Air Conditioning and Power and Energy. On the other hand, the candidates had poor performance in the topic of Automotive Electric System (Repair and Maintenance of Auto-Electric System). The factors that affected the candidates' responses include the candidates' failure to understand the demand of the questions, insufficient knowledge on some tested subject matters, and lack of automotive technical skills.

This report will help to identify the candidates' strengths and weaknesses for improvement before sitting for Certificate of Secondary Education Examination (CSEE). It will help teachers to identify the challenging areas and respond appropriately during teaching and learning process. The National Examinations Council of Tanzania (NECTA) expects that, the concerned stakeholders will use the feedback provided in this report to improve the teaching and learning processes for attainment of required instructional objectives. Consequently, students will acquire knowledge, skills and competence indicated in the syllabus for better performance in future examinations.

The Council appreciates the contribution of all those who participated to prepare this report.

Dr. Said Ally Mohamed
EXECUTIVE SECRETARY

1.0 INTRODUCTION

This report presents the candidates' performance on Certificate of Secondary Education Examination (CSEE) in Automotive Engineering subject. The report focuses on the candidates' competences as per ordinary level secondary education syllabus for the Automotive Engineering subject. It analyses the candidates' performance by revealing performance in each question as well as presenting the candidates' strengths and weaknesses in each question attempted.

The Automotive Engineering paper had 11 questions that were divided into three sections A, B, and C. Section A comprised of two questions. Question 1 had 10 multiple-choice items each carrying one mark while question 2 had six matching items. Section B consisted of six short answer questions each carrying nine marks. Section C consisted of three structured questions each carrying 15 marks. The candidates were required to answer all the questions in sections A and B, and choose two questions from section C to answer.

The candidates' performance is interpreted according to the ranges of marks generally scored by the candidates. The scores, which ranged from 0 to 29 marks were regarded as poor (weak) performance. Furthermore, the scores that ranged from 30 to 64 marks were termed as average performance. Finally, the scores, which ranged from 65 to 100 marks are referred as good performance. The weak, average and good performances are represented in colors in figures and tables. Specifically the red, yellow and green represented weak, average and good performance respectively.

A total of 183 candidates sat for the Automotive Engineering Examination, whereby 177 (96.72%) candidates passed while 6 (3.28%) failed. Figure 1 shows the performance of the candidates' grade wise.

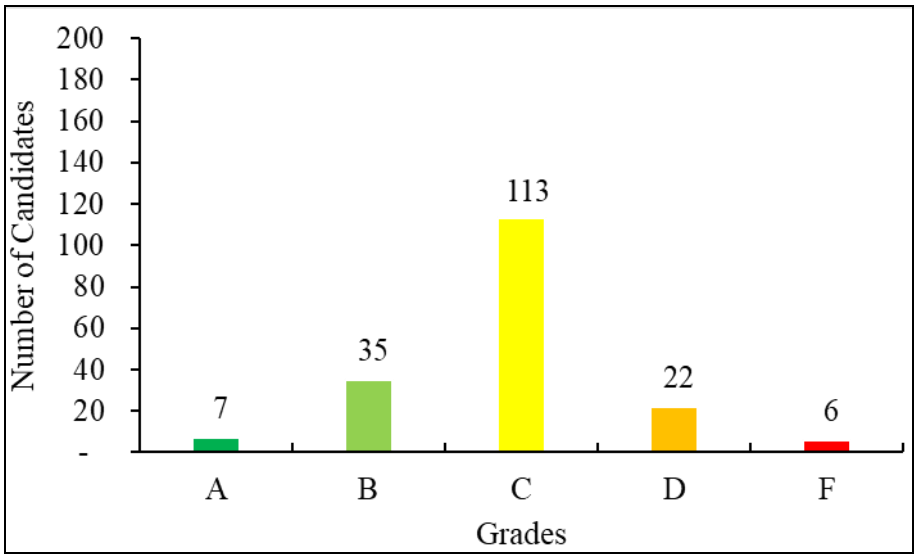


Figure 1: *Performance of Candidates Grade wise in 2023*

The analysis presents the requirements of each question, candidates' strengths and weaknesses in their responses. The percentage of candidates in each group of scores is presented using graphs. Finally, the report provides conclusion and recommendations.

2.0 THE CANDIDATES' RESPONSES ANALYSIS IN EACH QUESTION

2.1 SECTION A: Objective Questions

Section A comprised of two objective questions. Question 1 consisted of 10 multiple-choice items, each carrying 1 mark. On the other hand, while question 2 consisted of six matching items, each carrying 1 mark. Thus, this section carried 16 marks.

2.2.1 Question 1: Multiple Choice Items

This question had 10 items, (i) to (x). The sub-topics which were covered in this question were *Automotive Electric System, Automotive Systems I (Gearbox), Automotive Systems II (Steering System, Tyres,*

Braking Systems), Refrigeration and Air Conditioning, Engine Systems (Charging System), Tools and Equipment.

Question 1 was attempted by 183 (100%) candidates. The analysis indicates that, 24 (13.11%) candidates scored from 0 to 2 marks. Additionally, 153 (83.61%) candidates scored from 3 to 6 marks while only 6 (3.28%) candidates scored from 7 to 10 marks. The majority of candidates (86.89%) scored from 3 to 10 marks as demonstrated in Figure 2. The candidates who performed well were able to choose the correct options while the ones who performed poorly chose the wrong options to the given items.

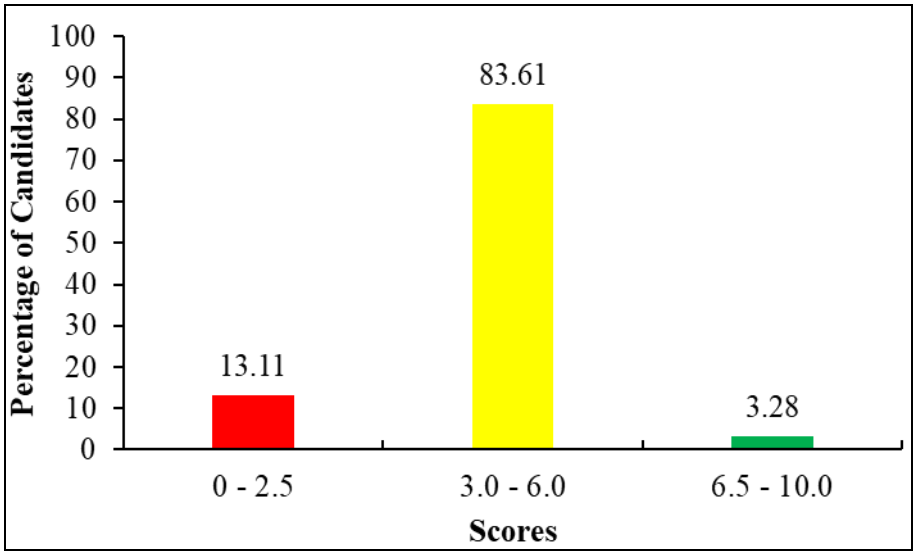


Figure 2: *The Candidates' Performance in Question 1*

Further analysis reveals that the item on which the majority of candidates responded correctly was item (v). This item measured the concept on *tyre maintenance* which included preliminary preparation such as positioning the car on a level surface and use wheel chocks to secure it. Despite the fact that many candidates selected the right response, few chose the incorrect one. They chose incorrect option due to the lack of knowledge and inability to transform the process of practical work of removing a tyre into theory. For example, those who chose option *'A' Placing the vehicle on a flat ground and lifting the vehicle using a jack*, lacked the knowledge that, vehicle cannot be lifted

using a jack before putting chocks to secures it. For those who chose option *'B' Placing safety stand to support the vehicle, release the jack and remove the tire,* were not knowledgeable to understand that, procedurally, vehicle cannot be put on safety stand to support it before positioned it on flat surface to reduce the inclination of the car. All who chose other alternatives rather than option 'C' were supposed to understand that, the first procedurally step and preliminary preparations for removing a tyre is to drive the vehicle to the flat surface and place chocks on the tyre to ensure there is no roll out once the vehicle is jacked up.

Items (i), (ii), (iii), (iv) (vi), (vii), (viii), (ix), and (x) were moderately correct selected, suggesting that majority of the candidates had necessary knowledge in the relevant topics. The item which most of the candidates wrongly selected was item (ii). The analysis of candidates' responses in each item is presented as follows:

Item (i) was composed from the topic of *Automotive Auxiliary System*. It intended to measure candidates' competence in identifying components/ parts of auto electric circuits. The question was as follows:

The modern vehicle had different motors to operate various systems. Which of the following motor is ***not*** *controlled by a spring loaded on-off switch?*

A	*Windshield wiper motor*	*B*	*Power window motor*
C	*Convertible top motor*	*D*	*Power antenna motor*
E	*Sun roof motor*		

The correct answer for this item was option D. *Power antenna motor*. Those who chose the correct option had knowledge that a switch commonly controls power antenna motors by raising or lowering it. They further understood that the switch used for power antennas is not typically a basic spring-loaded on-off switch designed to operate the antenna system rather than being operated by a spring-loaded on/off switch. Power antenna motors in cars are controlled by signals from the radio or the ignition switch.

Those who selected option A, *Windscreen wiper motor*, were unaware that an on-off switch controls it, which is spring-loaded. When disengaged, the switch automatically returns to the "off" position because of the spring-loaded mechanism thus as result, option A is incorrect because, a spring-loaded on/off switch controls the windscreen wiper motor.

For those who selected B, *Power window motor*, did not understand that, a spring-loaded on-off switch controls it. The switches are often momentary switches, that they only activate the motor while they are pressed. When disengaged, the switch automatically returns to the "off" position because of the spring-loaded Therefore, option B was the not correct answer because the power window motor switch is controlled by a spring-loaded on-off switch.

For those who chose option C, *the convertible top motor*, also lacked the knowledge that a spring-loaded on-off switch controls it. Convertible top motors are usually controlled by dedicated switches that are specifically designed for operating the convertible top mechanism. These switches may be momentary switches, similar to power window switches, which activate the motor while they are being pressed.

Conversely, individuals who chose Option E, *the sunroof motor*, were unaware that the sunroof motor is normally operated by a switch that turns on the motor to open or close the sunroof. Moreover, they were unaware that the control switch in the majority of cars with sunroofs is a temporary switch that the passenger or driver can press to open or close the sunroof.

Item (ii) was set from the topic *'Automotive Systems I (Gearbox).* It intended to measure candidates' ability to apply the concepts of Gearbox in daily real life. The question was as follows:
What causes abnormal noise in the gearbox when shifting gear from number four to five while the clutch is fully pressed?

A Clutch not engaging
B Gear loose on the main shaft
C Broken shift fork
D Broken counter shaft
E Worn synchronizer ring

Most of the candidates who attempted this item chose the correct response E, *Worn synchronizer ring*. Those who chose the correct option understood that synchronizer ring is a component in manual transmissions that facilitate smooth gear shifting by equalizing the speeds of gears before engagement. When these rings become worn or damaged, they may fail to synchronize the speeds of the gears properly, leading to grinding or abnormal noise during gearshifts.

For those who selected option A, *Clutch not engaging*, were unaware that an unusual noise in the gearbox during gear shifting could not be the result of a clutch that is not engaging. This is due to the possibility that the gearbox input shaft may stay partially engaged with the engine if the clutch fails to completely disengage upon depressing the pedal, which could result in a failure of the gear engaging.

Others selected option B, *Gear loose on the main shaft.* These candidates did not understand that, gear loose on the main shaft refers to a situation where one of the gears attached to the main shaft of the gearbox is not securely fastened or has excessive play but could not be the cause of abnormal noise in the gearbox when shifting gears rather that could cause difficult in gear engaging

For those who selected Option C, *A broken shift fork* they failed to understand that a broken folk could not certainly cause abnormal noise in the gearbox when shifting gears rather could cause difficult in gear engaging.

Moreover, some candidates opted for D, *A broken counter shaft.* These candidates failed to understand that a broken counter shaft could not cause abnormal noise in the gearbox when shifting gears. A broken counter shaft could result in misalignment or improper engagement of gears, which means gear could not be engaged at all and therefore there could be no possibility of noise coming from gears trying to engage.

Item (iii) was set from the topic *Automotive Systems II (Steering System).* It intended to measure candidates' ability in analyzing steering components in daily real life. The question was:

Form four students were given different components to arrange. Identify the components, which do not relate with the steering system.

A *Steering rings and steering fluid*
B *Steering wheel and steering shaft*
C *Steering column and steering linkage*
D *Steering gears and steering pump*
E *Steering box and steering join*

The correct answer was *A, Steering rings and steering fluid.* Steering rings and steering fluid are not typically associated with the steering system. Instead, they might be components of a hydraulic or power steering system, which are not generally present in all vehicles. The steering wheel, steering shaft, steering column, steering linkage, steering gears, steering pump, steering box, and steering joint are all integral parts of the steering system, responsible for controlling the direction of the vehicle.

For those who opted B, *Steering wheel and steering shaft,* did not understand that Steering wheel and steering shaft do relate to the steering system. The steering wheel is the component that the driver uses to control the direction of the vehicle, and the steering shaft is what connects the steering wheel to the steering mechanism, allowing the driver's input to be transmitted to the steering system. Therefore, both the steering wheel and steering shaft are integral parts of the steering system, making an option B incorrect one.

Some candidate chose option C, *Steering column and steering linkage*, as they did not know that steering column and steering linkage indeed relate to the steering system. They further did not know that, steering column is the component that houses various parts of the steering system, such as the steering wheel, steering shaft, and sometimes the ignition switch. It provides a connection between the steering wheel and the steering mechanism. The steering linkage on the other side refers to the collection of rods, arms, and other components that transmit the

motion from the steering mechanism (such as the steering gearbox or rack and pinion) to the steering knuckles, thus turning the vehicle's wheels. Therefore, both the steering column and steering linkage are essential components of the steering system, leading the option C to be not the correct response to this item.

Those who chose option D, *Steering gears and steering pump* were unaware that steering gears and the steering pump are essential parts of the steering system. They are in charge of converting the steering wheel's rotating motion into the lateral motion needed to turn the car's wheels. Steering pump an is integral part of power-assisted steering systems. With power steering systems, the steering pump produces hydraulic pressure that helps the driver spin the wheels more effortlessly.

Some candidates selected alternative E, *Steering box and steering joint*. These candidates did not understand that the Steering box and steering joint do relate to the steering system, and they are both essential components. The steering box or steering gearbox is a crucial component, particularly in older vehicles or those with recirculating ball steering mechanisms. It converts the rotational motion of the steering shaft into the side-to-side motion needed to turn the wheels. While some modern vehicles use rack and pinion steering instead of a steering box, it's still a common and important part of many steering setups. Furthermore, the candidate did not know that steering joint or steering coupling on the other hand is used to connect various components of the steering system, allowing for flexibility and movement while maintaining a solid connection. These joints are typically found in the steering linkage, connecting the steering shaft to the steering gearbox or rack and pinion, and in other parts of the steering mechanism where flexibility is needed.

Item (iv) was set from the topic *Refrigeration and Air Conditioning*. It intended to measure candidates' competence in identifying different types of refrigerant. The question was:

A school teacher's car is equipped with air conditioning system that uses refrigerant for better operation. What type of refrigerant is appropriate?

A Refrigerant 113 *B Refrigerant 22* *C Refrigerant 404*
D Refrigerant 134 *E Refrigerant 114*

The correct choice was D *Refrigerant 134* because the appropriate type of refrigerant for an air conditioning system in a car. The candidates who chose this option had the concept that Refrigerant 134, also known as R-134a, is the most commonly used refrigerant in automotive air conditioning systems today. It is environmentally friendly and has replaced older refrigerants like Refrigerant 12 (R-12) due to its lower ozone depletion potentials. Therefore, it is the suitable choice for a car's air conditioning system.

For those who chose option A, *Refrigerant 113*, lacked the concept on Refrigerant 113 as it is not an appropriate choice for the air conditioning system in a car because this refrigerant is a chlorofluorocarbon (CFC) refrigerant, which has been phased out due to its harmful effects on the ozone layer and its contribution to global warming.

Few candidates selected alternative B, *Refrigerant 22*. These candidates did not understand the Refrigerant 22 is not an appropriate choice for the air conditioning system in a car due to environmental concerns and regulatory restrictions. It is a hydro chloro fluoro carbon (HCFC) refrigerant, which, like other CFCs, has been phased out because of its harmful effects on the ozone layer and its contribution to global warming.

For those who chose option C, *Refrigerant 404* were not aware that this refrigerant is not an appropriate choice for the air conditioning system in a car. Furthermore, they did not understand that Refrigerant 404 is typically used in commercial refrigeration systems and is a blend of refrigerants, primarily consisting of hydrofluorocarbons (HFCs). It is not commonly used in automotive air conditioning systems.

Few candidates chose alternative E, *Refrigerant 114* (R-114). These candidates lacked the understanding that *Refrigerant 114* is not an appropriate choice for the air conditioning system in a car. Since this is a chlorofluorocarbon (CFC) refrigerant, which has, is phased out due to its harmful effects on the ozone layer and its contribution to global warming.

Item (v) was set from the topic 'Sound'. It intended to measure candidates' competence safety precaution in real life situation. The question was:
You are asked to remove the tire for maintenance. How will you make a preliminary preparation to the task?

A *Placing the vehicle on a flat ground and lifting the vehicle using a jack.*

B *Placing safety stand to support the vehicle, release the jack and remove the tire.*

C *Placing the vehicle on a flat ground and secure the vehicle by wheel chocks.*

D *Securing the vehicle by wheel chocks and remove the tire.*

E *Placing the wheel chocks and lift the vehicle.*

The correct answer was C, *Placing the vehicle on a flat ground and secure the vehicle by wheel chocks*. Many candidates chose the correct response. They had the concept that before removing a tire for maintenance, it's essential to ensure the vehicle is stable and secure for placing the vehicle on a flat surface which in turn helps prevent it from rolling during the tire removal process. Additionally, securing the vehicle with wheel chocks prevents any unintended movement while the tire is removed. This preliminary preparation ensures safety and stability throughout the maintenance task.

Others chose option A, '*Placing the vehicle on a flat ground and lifting the vehicle using a jack'*. These candidates did not understand that, this option was a plausible preparation step for removing a tire, but it did not encompass all the necessary preliminary precautions for safety.

Moreover, the candidates did not understand that simply lifting the vehicle with a jack without additional precautions could pose a safety risk. They were supposed to know that while lifting the vehicle using a jack is indeed a step in the process of removing a tire, it is crucial to ensure the vehicle is stable and secure before lifting it.

Other few candidates chose alternative B, *placing safety stand to support the vehicle, release the jack, and remove the tire*. These candidates were not aware that option B involved the use of safety stands, which were essential for supporting the vehicle securely while working on it. However, they failed to understand that the option did not mention the initial step of ensuring the vehicle is on a flat surface, which is crucial for stability during tire removal. Furthermore, the candidates were supposed to understand that before lifting the vehicle with a jack, it's essential to place it on a flat ground to prevent any rolling or shifting during the process. Additionally, while safety stands are important for supporting the vehicle after it had lifted, they are typically used in conjunction with a jack rather than as a standalone support.

For those who chose alternative D *Securing the vehicle by wheel chocks and remove the tire* did not understand that distractor D was not a complete answer because it lacks the initial step of ensuring the vehicle is on a flat surface. The candidates were supposed to know that before removing a tire, it was essential to place the vehicle on a flat ground to prevent any rolling or shifting during the process. While securing the vehicle with wheel chocks is an important step in preventing movement, but it should be preceded by placing the vehicle on a flat ground stable surface for car parking.

Many candidates chose E *Placing the wheel chocks and lifting the vehicle*. These candidates failed to understand option E is not a complete answer because it lacks the initial step of ensuring the vehicle is on a flat surface. They were supposed to understand that though option E includes an important safety measure with wheel chocks, it overlooks the initial step of placing the vehicle on flat ground for stability.

Item (vi) was composed from the topic *Auto-Electric Circuits*. It intended to measure candidates' ability to identify the function of different electrical components in automotive engineering. The question was:

Which device will you fix to protect an auto electric circuit of a charging system if overloaded?

A Capacitor B Transducer C PCB D Transistor E Fuse

The correct option was E, *Fuse.* The candidates who chose this response understood that in order to protect an auto electric circuit of a charging system from overloading one has to fix a fuse. They knew that fuse is a safety device designed to protect electrical circuits from overcurrent conditions. They further knew that fuse melt or blow interrupting the circuit and preventing from damage to the components downstream as the current flowing through the circuit exceeds a certain threshold.

For those who chose A, *Capacitor* were not aware that capacitors are not used as a protective device against overloads in auto electric circuits of charging systems but are electronic components used for storing and releasing electrical energy in circuits. Therefore, capacitors are not primarily used as protective devices against overloads.

Some candidates chose option B *Transducer*. They did not know that transducer is not typically used as a protective device against overloads in auto electric circuits of charging systems in turn it is a device that converts one form of energy into another, such as converting mechanical energy into electrical energy or vice versa. Therefore, candidates were not knowledgeable that, though transducers may serve other functions within electrical circuits but they are not appropriate device for protecting against overloads in auto electric circuits of charging systems.

Few candidates opted for C, *PCB* that stands for *Printed Circuit Board*. These few candidates did not have the knowledge PCB are used to mechanically support and electrically connect electronic components using conductive pathways, tracks, or signal traces etched from copper

sheets laminated onto a non-conductive substrate. Therefore, PCB is not used as a protective device against overloads in auto electric circuits of charging systems. Furthermore, the candidates lacked the knowledge that, PCBs play a crucial role in organizing and routing electrical connections in electronic devices, but they are not designed to protect against overloads.

Option D, *Transistor* was not the correct response. Therefore, for those candidates who chose it were not aware that transistors are semiconductor devices that can amplify or switch electronic signals and power. They are not used as a protective device against overloads in auto electric circuits of charging systems.

Item (vii) was set from the topic *Automotive Electric System*. It intended to measure the candidates' competence in identifying specific technician for a particular electrical system maintenance job. The question was:

If the vehicle has a problem in electrical system, who would you seek to perform maintenance?

A Motor vehicle service technician
B Electrical technician
C Auto body repair technician
D Auto electric and electronic technician
E Air conditioning and auto electric technician

The correct answer was D, *Auto electric and electronic technician.* For those who chose the correct response they understood that for maintenance on the electrical system of a vehicle, the most suitable professional to seek would be an auto electric and electronic technician. They further comprehended that, these technicians specialized in diagnosing and repairing electrical issues in vehicles, making them the most appropriate choice for addressing problems within the vehicle's electrical system.

The candidate who chose option A, *Motor vehicle service technician* was unaware that this technician could be able to do maintenance on different parts of a car, such as basic electrical system inspections and

repairs. They would not however be as skilled in identifying and fixing complicated electrical problems as an auto electric and electronic specialist would.

For those who selected option B, *Electrical technician* failed to realize that electrical technician could potentially possess skills and knowledge relevant to electrical systems, but the specificity required for automotive electrical systems would not be their primary focus. Furthermore, the candidates did not know that while an electrical technician would have expertise in electrical systems in general, automotive electrical systems can be complex and require specialized knowledge of automotive electronics, wiring diagrams, diagnostic tools, and troubleshooting techniques. They were supposed to understand that, an auto electric and electronic technician specifically specializes in diagnosing and repairing electrical issues within vehicles, making them better suited for maintenance on a vehicle's electrical system compared to a general electrical technician.

Few candidates chose option C *Auto body repair technician.* These candidates did not understand that Auto body repair technician are primarily specialized in repairing and restoring the body of vehicles, including tasks such as dent repair, painting, and panel replacement. While they may have some basic understanding of vehicle systems, their expertise is not typically focused on diagnosing or repairing issues within the electrical system of a vehicle. Furthermore, the candidates were supposed to know that, automotive electrical systems involve complex wiring, components, and electronic control units (ECUs) that require specialized knowledge and training to diagnose and repair. Therefore, auto body repair technicians are not typically trained in diagnosing or repairing electrical issues within vehicles.

For those who chose option E, *Air conditioning and auto electric technician* failed to digest that this option combined expertise in both automotive air conditioning systems and auto electrical systems. In addition, the candidates were supposed to understand that while this technician may possess knowledge and skills related to automotive electrical systems, their primary focus and specialization usually lie

more heavily in air conditioning systems. They may be capable of diagnosing and repairing basic electrical issues in vehicles, including those related to air conditioning systems, their expertise may not be as extensive or specialized as that of an auto electric and electronic technician, therefore this alternative was not correct for this item.

Item (viii) was set from the topic *Engine Systems (Charging System)*. It intended to measure candidates' competence in tracing possible fault on charging system. The question asked:

A customer sent his vehicle to the workshop complaining that the charging warning lamp is ON when the engine is running. What might be the possible fault?

A Blown warning light bulb
B Loose or broken wiring connection
C Open circuit in warning light circuit
D Closed circuit in alternator wiring
E Short circuit on warning light circuit

The correct response for this item was D *Closed circuit in alternator wiring*. Those who chose this alternative understood that a closed circuit in the alternator wiring means that there is a continuous path for electrical current, which can cause the charging system to malfunction, resulting in the warning lamp staying illuminated. They further understood that, this fault could occur due to various reasons such as damaged wiring, faulty connections, or a malfunctioning alternator. In addition the candidate were knowledgeable that when the charging warning lamp remains illuminated while the engine is running, it typically indicates an issue with the charging system, often related to the alternator.

For those who chose option A, *Blown-warning light bulb* were not conversant to understand that if the warning light bulb is blown, it would indeed prevent the charging warning lamp from illuminating at all. Therefore, the candidates were supposed to notice that this option was not the most likely cause in this situation of the charging warning

lamp being ON when the engine is running, thus making to be not the correct answer.

The candidates who selected option B, *Loose or broken wiring connection* confused with this option because it was a very close distractor. The candidates were correct to think that if there is a loose or broken wiring connection in the charging system, it could disrupt the flow of electrical current and cause the charging warning lamp to illuminate. However, they did not realize it was worth noting that that situation would normally result in intermittent illumination of the lamp, as the connection may intermittently make and break contact. Therefore, the candidates were supposed to understand that the option B was a plausible answer, but it would not be possible cause and let the charging warning lamp to be ON all the time when the engine is running

Option C, *Open circuit in warning light circuit* was confusing since it is true that an open circuit in the warning light circuit meant a break or discontinuity in the electrical path between the warning light and the charging system. However, most of the candidates did not recognize that this break in the circuit prevents the warning light from receiving the signal to turn off, resulting in the lamp not remaining illuminated.

Some candidate chose option E, *Short circuit on warning light circuit*. These candidates did not understand that short circuit on warning light circuit is not a likely cause of the charging warning lamp being ON when the engine is running. Furthermore, they were not aware that a short circuit on the warning light circuit would typically result in an overload of electrical current, which could cause the warning light fuse to blow or damage the wiring. In such a scenario, the charging warning lamp would not illuminate or the fuse would blow causing the lamp to turn off. Therefore, candidates were supposed to understand that as a short circuit could potentially cause issues with the charging system, it is not a likely cause of the charging warning lamp remaining ON when the engine is running.

Item (ix) was set from the topic *Tools and Equipment*. It intended to test the candidates' ability to apply the knowledge and skills when employing tools and equipment in daily life. The question was:

Ratchet is one of the tools that can be placed in a group speed handle tools and cannot be used in heavy torque. What is its turning direction when is used?

A *It turns freely in one direction and drives the socket in other direction*
B *It turns freely in both directions*
C *It turns freely in one direction and drives the socket in other direction*
D *It drives the socket in both directions*
E *It locked in both directions and drives the socket in any directions*

The correct answer is A and C, *It turns freely in one direction and drives the socket in the other direction respectively*. The candidate who chose the correct answer were able to understand that ratchets are designed to allow rotation in one direction while locking in the opposite direction, allowing for efficient tightening or loosening of nuts and bolts without having to reset the tool.

Option B, *It turns freely in both directions* was not the correct answer because this option does not accurately describe the function of a ratchet. Those who chose this option did not know that ratchet is typically has a mechanism that allows it to turn freely in one direction (the loosening direction) while locking or engaging to drive in the opposite direction (the tightening direction). Therefore, the candidate had to know that option B was not the correct answer because it did not explain the unique functionality of a ratchet.

The candidate who selected D, *It drives the socket in both directions*, were not aware that a ratchet tool typically has a mechanism that allows it to turn freely in one direction (loosening) and drives the socket in the other direction (tightening). Therefore, option D was not typically accurate for a standard ratchet tool.

Those who selected option E, *It locked in both directions and drives the socket in any direction* were not aware that this option did not accurately describe the function of a ratchet tool. In addition, they lacked the understanding that ratchet typically has a mechanism that allows it to turn freely in one direction usually the loosening direction while engaging to drive the socket in the opposite direction typically the tightening direction.

Item (x) was set from the topic *Automotive Systems II (Braking System).* It intended to test the candidates' ability to describe the law governing brake fluid that is transmitted equally within the system. The question was:

When a driver presses the brake pedal, brake fluid is transmitted equally within the system. Which law is most applicable in this case?

A Charles law *B Pascal's law* *C Pressure law*
D Boyle's law *E Newton's law*

The correct alternative was B, *Pascal's law*. Those who chose this option understood that with regard to Pascal's law, pressure exerted on a fluid inside a small area transmits equally throughout the fluid in all directions. Furthermore, they were aware that, when a driver presses the brake pedal, the pressure is applied to the brake fluid in the brake lines as such according to Pascal's law; this pressure is transmitted equally throughout the brake fluid, which then applies force equally to all parts of the braking system.

Those who chose option A, *Charles's law*, were not aware that this option was not applicable to this scenario because it describes the relationship between the volume and temperature of a gas when pressure is held constant. The candidate did not understand that Charles's law states that, at constant pressure, the volume of a gas is directly proportional to its absolute temperature. Furthermore, the candidates did not understand that Charles's law deals with the behavior of gases, not fluids like brake fluid.

Some candidates chose option C *Pressure law*. These candidates did not understand that brake fluid transmitted equally within the system

presents Pascal's law and not pressure law. Furthermore, they were not aware that there is no such a law recognized or called *pressure law* though there are gas laws whereby they relate to pressure, volume, and temperature of a gas. For example Boyle's law which states that, *at constant temperature, the pressure P of a gas varies inversely with its volume V, or PV = k,* where *k* is a constant. There is also Charles's law which states that, *at constant pressure, the volume V of a gas is directly proportional to its absolute (Kelvin) temperature T, or V/T = k*

Few candidates chose alternative D, *Boyle's law*. These candidates confused this law with Pascal's law. They did not know that *Boyle's law* is not applicable in this situation because it describes the relationship between the pressure and volume of a gas when the temperature is held constant. In addition, Boyle's law deals specifically with the behavior of gases, not fluids like brake fluid. These candidates were supposed to understand that, when the brake pedal is pressed, the focus is on the transmission of pressure through the brake fluid, not changes in volume.

On the other hand, few candidates opted for alternative E, *Newton's law*. These candidates did not know that the law of Newton's law is not specific law or principle in this context of pressure exerted on a fluid inside a small area and transmitted equally throughout the fluid in all directions. They further did not know that Newton's laws of motion describe the behavior of objects in response to forces and the resulting motion.

2.2.2 Question 2: Matching Items [Automotive Systems I (The Clutch)]

This question was set from the sub-topic, *the Clutch*. It was designed to evaluate a candidate's ability to analyse clutch assembly components with regard to their functions. The question was:

*Match each functions of clutch assembly components in **List A** with the appropriate clutch assembly component in **List B** by writing a letter of the correct response besides the corresponding item number in the answer booklet provided.*

List A	*List B*
(i) It forces the throw-out bearing into the clutch pressure plate *(ii) It acts as a return spring so that when the clutch pedal is not pushed down, the bearing allows the fingers to return outwards* *(iii) It disconnects the drive between the engine and gearbox when the drivers operate the clutch pedal* *(iv) It connects and disconnects the flow of power from one unit to another* *(v) It transfers movement from the clutch pedal to the throw-out fork* *(vi) It pushes against the clutch fingers when the pedal is pushed down to release the drive*	*A Clutch linkage* *B Clutch fork* *C Thrust bearing* *D Clutch* *E Release bearing* *F Pressure plate* *G Release spring* *H Withdraw spring*

This question was attempted by 183 (100%) candidates. The results in Figure 4 indicates that, 65 (35.52%) of the candidates scored from 0 to 1.5 marks; 107 (58.47%) of candidates scored marks from 2 to 3.5 marks, while 11(6.01%) of the candidates scored from 4 to 6 marks. The majority of the candidates, 118 (64.48%) scored from 2 to 6 marks. Therefore, this question had average performance as shown in Figure 3. This is the questions which was average performed.

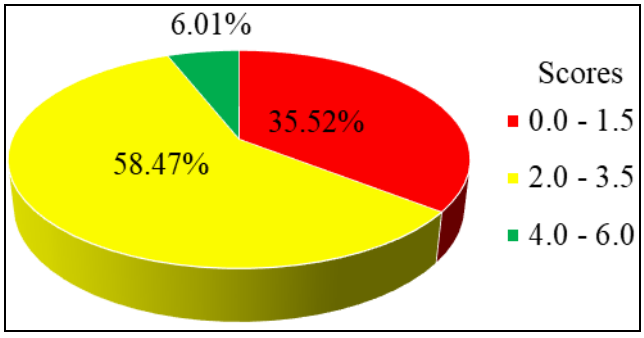


Figure 3: *The Candidates' Performance in Question 2*

The candidates who had high performance scored marks from 4-6 had adequate knowledge and skills on ability to analyse clutch assembly components with regard to their functions. Furthermore, the candidates

who had average performance (2-3) marks had inadequate knowledge about the functions of clutch components. This is because the candidates were able to match only some of the items.

Conversely, the candidates who scored low marks from 0 to 1.5 marks either gave incorrect responses to all the items or gave correct response to only one item, hence loss of marks. This indicates that, the candidates lacked or had insufficient knowledge of clutch components and their application. The following is the analysis of the candidates' responses in each item.

Item (i) required the candidates to select a response, which correctly matches the description of function of a clutch component. The correct response was B, *Clutch fork*. Most of the candidates matched it correctly, indicating that they were aware of clutch component and their application. However, few candidates matched with F, *Pressure plate*. These candidates failed to understand that *Pressure plate* creates friction between the clutch disc and the flywheel, enabling the transmission of power from the engine to the transmission system.

Item (ii) required the candidates to select a response, which correctly matches the description of a components of a clutch which acts as a return spring so that when the clutch pedal is not pushed down, the bearing allows the fingers to return outwards. The correct answer was G, *Release spring*. Few candidates matched it correctly. However, most of the candidates matched with H, *Withdraw spring*. These candidates failed to understand that *Withdraw spring* is a component, which exerts a pulling force on the selector mechanism, counteracting the force applied by the driver during gear selection.

Item (iii) required the candidates to select a response, which correctly matches the description of a clutch component, which disconnects the drive between the engine and gearbox when the drivers operate the clutch pedal. The correct answer was D, *Clutch*. Most of the candidates matched it correctly, indicating that they have adequate knowledge about configuration of clutch components and gearbox at large. However, some of them matched with A, *Clutch linkage*. They failed to

understand that, this linkage transmits the motion of clutch pedal to the clutch release mechanism when the driver presses the brake.

Item (iv) required the candidates to select a response which correctly matches the description of a component used to connects and disconnects the flow of power from one unit to another. The correct answer was D, *Clutch*. Most of the candidates failed to match it correctly indicating that they had inadequate knowledge about the action of connecting and disconnecting different gears.

Item (v) required the candidates to select a response, which correctly matches the description of a component, which transfers movement from the clutch pedal to the throw-out fork. The correct answer was A, *Clutch linkage*. However, some of the candidates matched it with D, *Clutch*. These candidates failed to understand that Clutch linkage transfers movement from the clutch pedal to the throw-out fork.

Item (iv) required the candidates to select a response which correctly matches the description of a component which pushes against the clutch fingers when the pedal is pushed down to release the drive. The correct answer was C *Thrust bearing* or E *Release bearing*. Most of the candidates failed to match it correctly indicating that they had inadequate knowledge about the action of thrust or release bearing. Besides, they did not know that The terms ‘release bearing’ and ‘thrust bearing’ are often used interchangeably, as they refer to the same component within the context of a clutch assembly.

2.2 SECTION B: Short Answer Questions

2.2.3 Question 3: Tools and Equipment

This question was set from the topic, *Tools and Equipment*. It was designed to evaluate a candidate's ability to select different types of tools when tightening, removing and refitting, testing and diagnostic and lifting equipment to pursue different motor vehicle mechanics activities carried out in a garage. The question was:

Technicians were told by their workshop foreman to perform the following tasks:

(i) Engine disassembly and inspection

(ii) Cleaning engine parts and replacing a drive belt.

Suggest three tools which the technicians should use to accomplish each task.

A total of 183 (100%) candidates attempted the question. The results in Figure 3 indicate that, 10(5.46%) candidates scored marks from 0 to 2.5. Additionally, 36 (19.67%) candidates scored from 3.0 to 4.5 marks, while 137 (74.86%) candidates scored between 6.5 and 9 marks. The majority candidates (66.4%) had good performance in this question as they achieved to score either 3 marks and above. Therefore, this question was well-performed question as the majority candidates scored average and above.

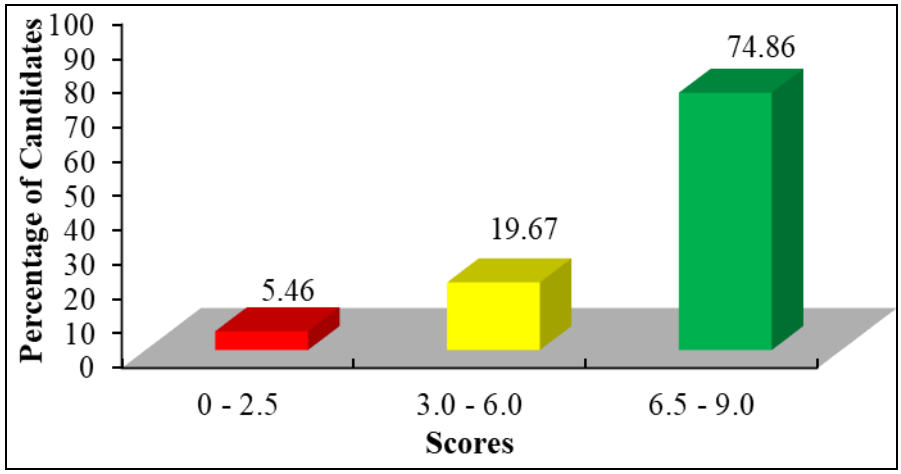
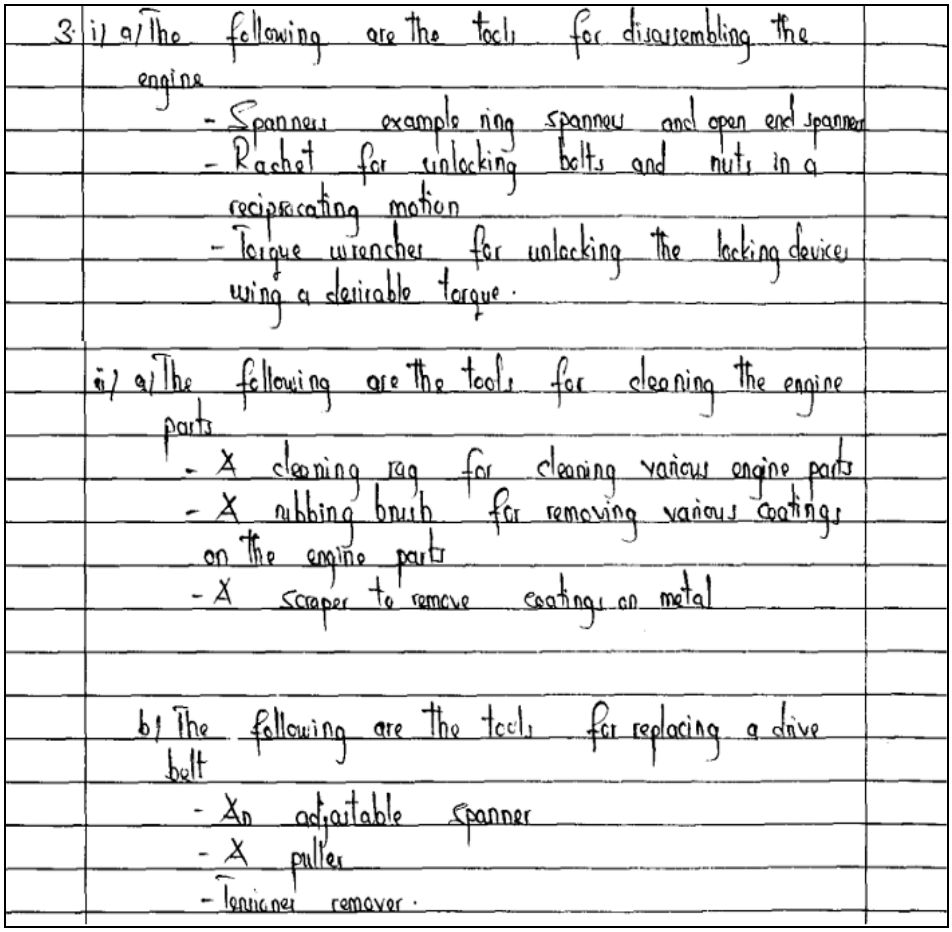


Figure 4: *The Candidates' Performance in Question 3*

The analysis shows that the candidates who got good marks were able to answer part (a) and part (b). For those who scored all 9 marks, in part (a) demonstrated their understanding on tool and equipment by suggesting the tools for engine disassembly namely; chain on lifting crane, different spanners such as socket set, torque wrench, bushing driver, hammer, screw drivers and for inspection as an inspection mirror and light of a bright LED light. In part (b) these candidates were able to suggest the tools and equipment for cleaning engine parts namely; parts

washer, hone type brush and for replacing a drive belt suggested the right tools which are box spanners, screw drivers and belt routing diagram. The responses provided by these candidates demonstrated adequate knowledge and skills related to automotive maintenance and repair. Specifically, they had good technical knowledge of engine components as they understood the components of an engine and the procedures involved in disassembly, inspection, cleaning, and reassembly. This knowledge led them to know which tools are necessary for each task hence showed understanding of tool selection and application and consequently meeting question demand. These include knowledge of tools commonly used in automotive maintenance, their functions and how to use them safely and effectively. Extract 3.1 portrays a sample of a candidate's response who had good performance.


3. i) a) The following are the tools for disassembling the engine
- Spanners example ring spanner and open end spanner
- Rachet for unlocking bolts and nuts in a reciprocating motion
- Torque wrenches for unlocking the locking devices using a desirable torque.

ii) a) The following are the tools for cleaning the engine parts
- A cleaning rag for cleaning various engine parts
- A rubbing brush for removing various coatings on the engine parts
- A scraper to remove coatings on metal

b) The following are the tools for replacing a drive belt
- An adjustable spanner
- A puller
- Tensioner remover.

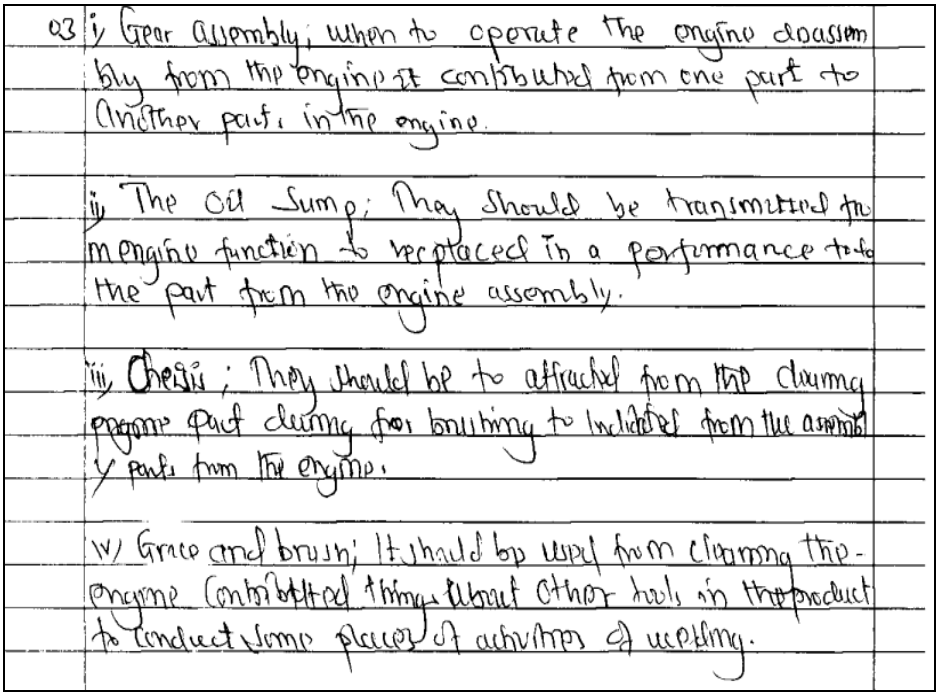
Extract 3.1: A sample of good responses to Question 3

Extract 3.1 is a sample of good responses from the candidate who wrote the correct answers by suggesting three tools, which the technicians could use to accomplish each task in (i) and (ii) thus, he/she ended up with correct response.

Further analysis reveals that, those candidates who had an average performance were only able to provide either correct answers in part (a) and failed in part (b) or failed part (a) and obtained correct answers in part (b), thus scored average marks. Those who got all marks in part (a) they were able to suggest all three tools, which should be used to accomplish task of engine disassembly and inspection. They suggested different tools such as *spanners* whereby they demonstrated them as *ring spanners* and *open end spanner* and ratchet *for opening bolts and nuts.* For those who obtained only part (b) managed to suggest three tools to be used to accomplish the task of cleaning engine parts and replacing a drive belt whereby they responded with the following answers; *parts washer, hone type brush, box spanners*, *screw drivers, belt routing diagram, allen keys*. Through the analysis of the responses of most of the candidates show that they had partial knowledge and skill for demonstrating tools especially with regard to practical experience in automotive repair and maintenance thus they scored average marks.

Although many candidates scored average and above in this question, there were 10(5.46%) candidates who scored below average. Some of these candidates scored 0 while others scored 1.5 marks. Those candidates who scored zero lacked understanding and competence in both theory and practice. This was because, in addition to recalling from memory what they had learned, in both part (a) and (b) candidates had to recall the tools needed for car maintenance and repair from their actual practical work. Therefore, these candidates lacked knowledge and skills from practical works. The candidates who scored 1.5 marks could only suggest one general tool in either part (a) or (b). Most of them suggested only one tool in part (a) such as *spanners* without any demonstration of other tools such as ring spanner and open end spanners. Others just mentioned the *container for washing* in part (b) without any other tools. Some candidates' responses, it showed that

they lacked knowledge about the components of engines, as well as the procedures involved in their disassembly, inspection, and maintenance. Furthermore, the candidates were not familiar with tools and equipment and their responses indicated gaps in both theoretical knowledge and practical skills related to automotive engineering and mechanics. Extract 3.2 shows a sample of the candidates who scored 0 mark.


Q3 i) Gear Assembly; when to operate the engine disassembly from the engine it contributed from one part to another part in the engine.

ii) The Oil Sump; They should be transmitted the engine function to replaced in a performance to the part from the engine assembly.

iii) Chesis; They should be to attached from the cleaning engine part cleaning for brushing to included from the assembly parts from the engine.

iv) Grace and brush; It should be used from cleaning the engine contributed thing about other tools in the product to conduct some pieces of activities of working.

Extract 3.2: A sample of the poor responses to Question 3

Extract 3.2 is a sample of poor responses by the candidate who failed to suggest correct tools, which the technicians could use to accomplish each task in (i) and (ii).

2.2.4 Question 4: Engine Systems

This question was set from the topic, *Engine Systems*. It intended to test the candidates' ability in arranging engine parts into the relevant systems. The question was:

The following are the components of the engine namely, water pump, injector, alternator, thermostat, battery, fuel tank, temperature gauge,

lift pump, and voltage regulator. Group the components in their respective engine system.

The question was attempted by 183 (100%) candidates. The results in Figure 4 indicate that, 21(11.48%) of the candidates scored from 0 to 2.5 marks; 11(6.01%) of the candidates scored marks from 3 to 5.5 marks while 151(82.51%) of the candidates scored from 6 to 9 marks. The majority of the candidates, 162 (88.52%) scored average and above in this question.

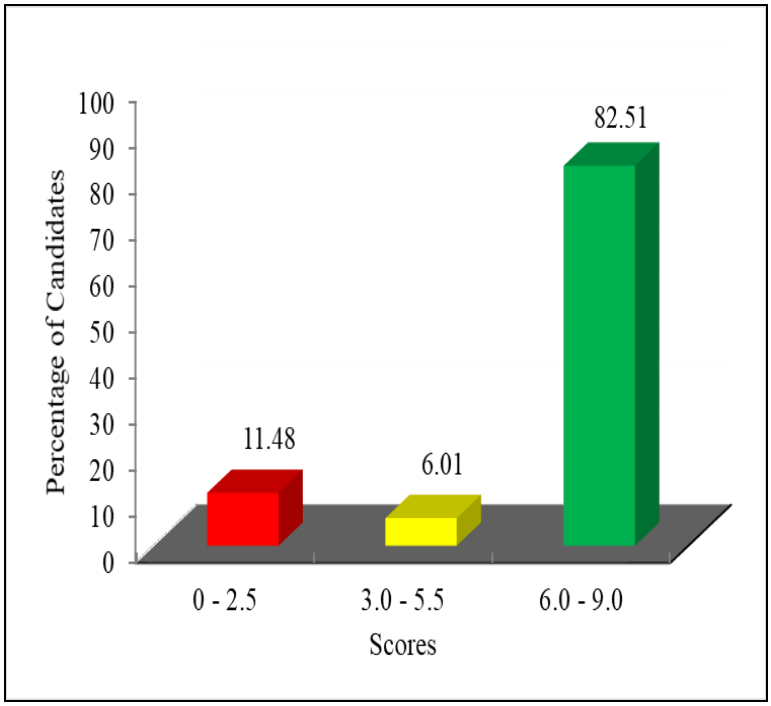


Figure 5: *The Candidates' Performance in Question 4*

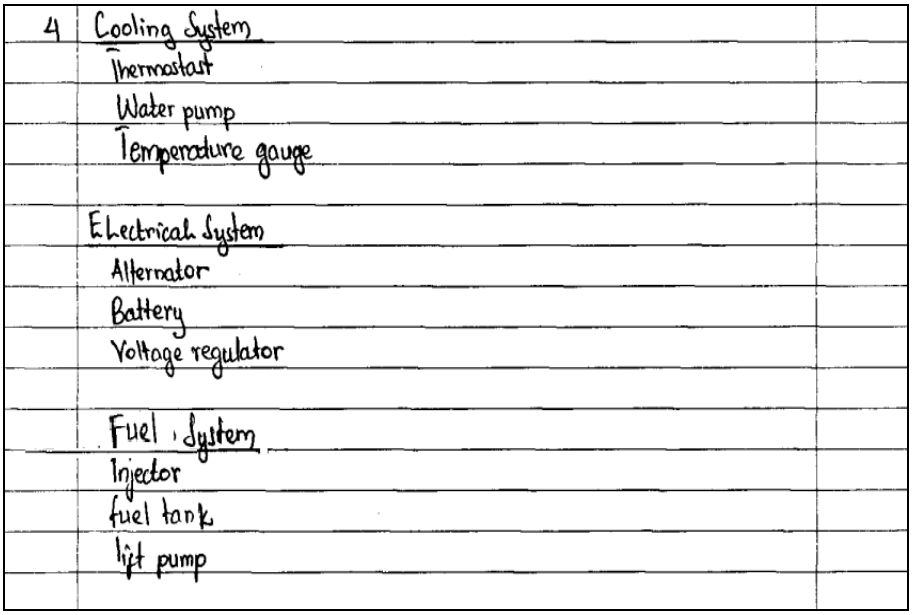
Furthermore, 151(82.51%) candidates scored a good score in which the majority of them scored all 9 marks allotted to this question. These candidates successfully grouped the engine's parts and managed that each part was placed in its proper group. They were able to identify the system the component belongs to, such as charging system, cooling system and fuel system. Their responses showed that correctly responding to this question demonstrated a strong understanding of

automotive engineering systems and ability to use that understanding in a practical context.

Despite of those candidates who got all the marks, there were those who scored high but below 9 marks. These candidates were able to arrange most of the components of the engine but they missed to arrange some components. For example, components of the engine that were not correctly arranged in their respective groups were, temperature gauge and lift pump.

Most of the candidates made mistake in arranging these components, they arranged the temperature gauge with the battery and the lift pump was arranged with the water pump, thus leading to not scoring all allotted marks. In the case of temperature gauge and battery there was a confusion of similarities in appearance, since both the signals of battery and temperature gauge are typically located in the instrument dashboard of a vehicle, which led the candidates to collect them together based on their physical nearness.

On the other hand, those who mistakenly arranged lift pump and water pump together confused as both components contain the word ‘pump’ which led to confusion of candidates, especially for those who were less familiar with automotive engineering terminology. The similarity in names caused the candidates to overlook the differences in their functions thus incorrectly arranged them together. These candidates did not understand that temperature gauge belong to the cooling system group and lift pump to the fuel system group, as temperature gauge serves the function of monitoring the temperature of the engine coolant and lift pump or fuel pump serves the function of transporting fuel from the fuel tank to the engine. Extract 4.1 shows a good response.



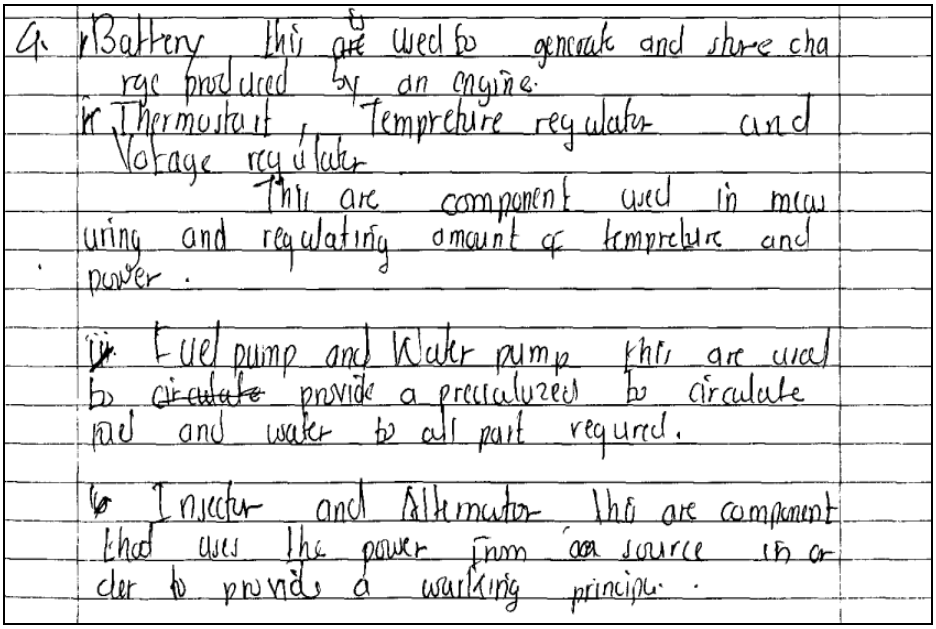
Extract 4.1: A sample of good responses to Question 4

Extract 4.1 shows a response from a candidate who was able to arrange the engine components to their respective engine systems.

The candidates who achieved mediocre were only able to group some components of engines with their respective engine system. Most of these candidates were able to arrange the charging system correctly but failed on other engine systems since they mixed up their components. For example, one candidate arranged the charging system correctly but on the cooling system wrote only one component 'water pump'. In the fuel system on the other hand, the candidate piled up all the remaining components so he/she ended up getting average marks. Most of the candidates in this group seemed to know only some of the components of the engine, so they could not arrange them all correctly. Most of them had partial knowledge and skill to understand that, each group of engine components represented components that work together within their respective engine systems.

Despite of good performance in this question, there were candidates who performed poorly and seemed to lack understanding and competence to arrange engine components to their respective engine

systems. The analysis showed that all 21(11.48%) of the candidates with weak performance scored 0 marks because they did not arrange all the engine components instead they were divided into groups without considering their respective group of system. The analysis revealed that, no one in this group got a score between 0.5 and 2.5 as all of them got zero because they grouped engine components by guessing and did not apply knowledge and skills related to engine components and their systems in engine performance. Due to their inability to distinguish between the engine system and irrelevant groupings of engine components, these candidates scored. These candidates did not know that each group of engine components represented components that work together within their respective engine systems. Extract 4.2 shows a poor response.


4. i Battery This are used to generate and store charge produced by an engine.
ii Thermostat, Temprature regulater and Voltage regulater
This are component used in measuring and regulating amount of temprature and power.
iii Fuel pump and Water pump this are used to ~~circulate~~ provide a preciaurzed to circulate fuel and water to all part required.
iv Injector and Alternator This are component that uses the power from a source in order to provide a working principle.

Extract 4.2: A sample of the poor responses to Question 4

Extract 4.2 shows a response from a candidate who was not able to arrange the engine components to their respective engine systems.

2.2.5 Question 5: Automotive Systems II (Braking System)

This question was set from the topic, *Automotive Systems II (Braking System).* It intended to measure the candidates' ability to evaluate the value in quality when comparing a disc brake from of drum brake. The question was:

You are required to recommend to the customer to purchase a disc brake instead of drum brake. Convince the customer by giving three advantages and disadvantages of the disc brake.

The question was attempted by 183 (100%) candidates. Among them, 10 (5.46%) of the candidates scored from 0 to 1.5 mark; 32 (17.49%) candidates scored from 3.0 to 4.5 marks; while 141 (77.05%) candidates scored from 6.0 to 9.0 marks. Figure 6 shows the candidates' performance summary of this question.

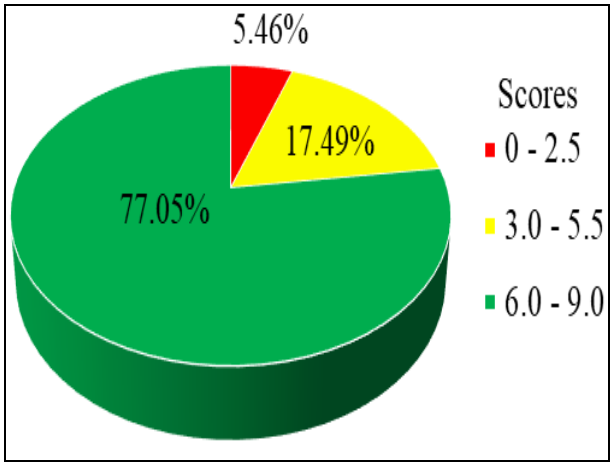
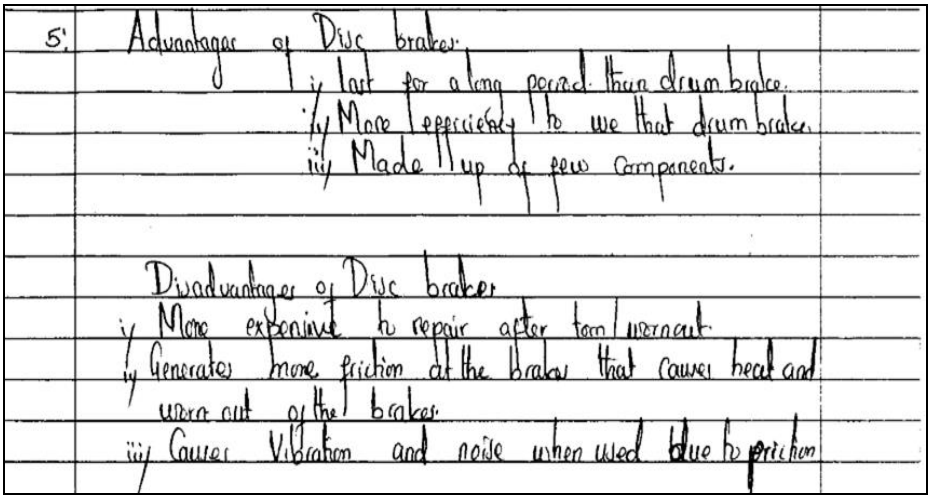


Figure 6: The *Candidates' Performance in Question 5*

The analysis shows that, the majority of the candidates 173 (94.54%) scored average and above. Among the given candidates, 30 (16.39%) who scored all marks, were able to give three advantages and disadvantages of the disc brake. These are the disc brakes offer better stopping power and more consistent performance, especially under high-speed or heavy braking conditions. They also convinced that, disc brake dissipate heat more effectively thus reduces the risk of brake fade

and providing shorter stopping distances. Furthermore, the disc brakes are easier to maintain and service compared to drum brakes, since they have fewer components, making inspections, repairs, and replacements simpler. Additionally, components such as brake pads and rotors are typically easier to access and replace compared to drum brake For example, one candidate attempted the question correctly by writing one of the advantage as, *the disc brake is easy to maintain and repaired*. On the other hand, the candidates also provided the disadvantage of the disc brake over drum brake such that *disc brake systems are more expensive to install and prone to corrosion compared to drum brakes*. For example, another candidate attempted the question correctly by writing one of the disadvantages, as *the disc brake is expensive to purchase and maintain*. Extract 5.1 is a sample of the good responses.


5. Advantages of Disc brakes.
i) last for a long period than drum brake.
ii) More Efficiency to we that drum brake.
iii) Made up of few components.

Disadvantages of Disc brakes
i) More expensive to repair after tear/ wear out.
ii) Generates more friction at the brakes that causes heat and wears out of the brakes.
iii) Causes Vibration and noise when used due to friction

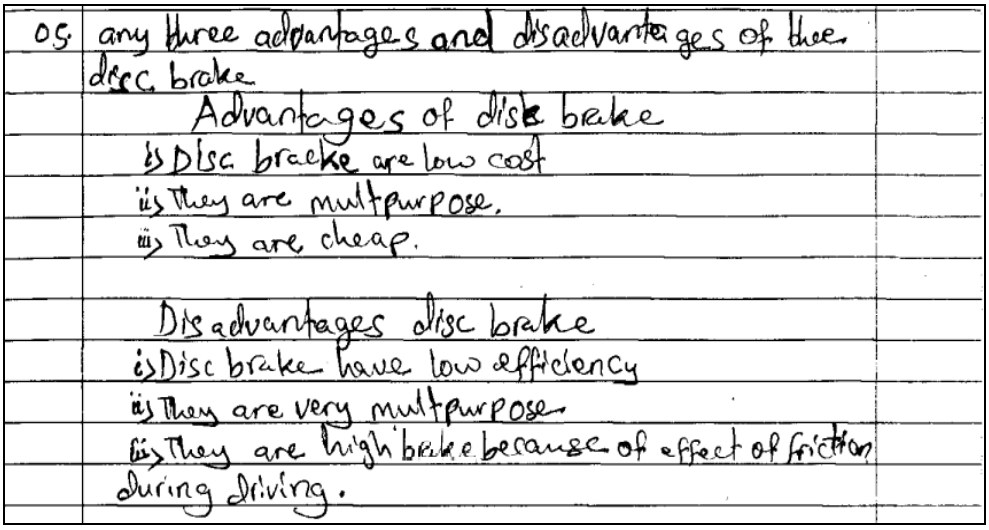
Extract 5.1: A sample of good responses to Question 5

Extract 5.1 is the sample of good responses from the candidate who managed to provide correct the advantages and disadvantages of disc brake over drum brake.

Further analysis shows that, those who got average marks made some mistakes. For example, one candidate wrote advantage only hence scored average marks. Others wrote advantage and some disadvantages thus ended up with average marks. The analysis reveals that, these candidates had difficult in remembering advantages and disadvantages

by writing more advantages than disadvantages or vice versa thus they ended up with mediocre scores.

A few candidates 10 (5.46%) who failed this question could not remember the advantages and disadvantages. These candidates had inadequate knowledge in the concept of brake system that was required to recommend to the customer to purchase a disc brake instead of drum brake. Most of these candidates interchanged some of the advantages with disadvantage of disc brake over drum brake. For example, one candidate incorrectly wrote, *disc brake is heavier than drum brake* as one of disadvantage of disc brake over drum. Apart from those who scored 0 mark, few 6 (3.28%) managed only to write either one advantage or disadvantage thus ended up with weak score. Therefore, these candidates failed to highlight the advantages and disadvantages; as a result, they could fail as well to effectively convince the customer to choose disc brakes over drum brakes for their vehicle, especially if they had to prioritize improved stopping power, easier maintenance, and better heat dissipation. Extract 5.2 is a sample of the poor responses by one of the candidates in this question.


05 any three advantages and disadvantages of thee disc brake

Advantages of disk brake

i) Disc bracke are low cost

ii) They are multpurpose.

iii) They are cheap.

Disadvantages disc brake

i) Disc brake have low efficiency

ii) They are very multpurpose

iii) They are high brake because of effect of friction during driving.

Extract 5.2: A sample of poor responses to Question 5

Extract 5.2 is the sample of poor responses from the candidate who managed to provide correct the advantages and disadvantages of disc brake over drum brake.

2.2.6 Question 6: Automotive Electric System (Repair and Maintenance of Auto-Electric System)

This question was set from the topic, *Automotive Electric System*. It intended to test the candidates' competence to explain the correct connection of the terminal from power source to the starter motor and disconnect the wrong connection. The question was:

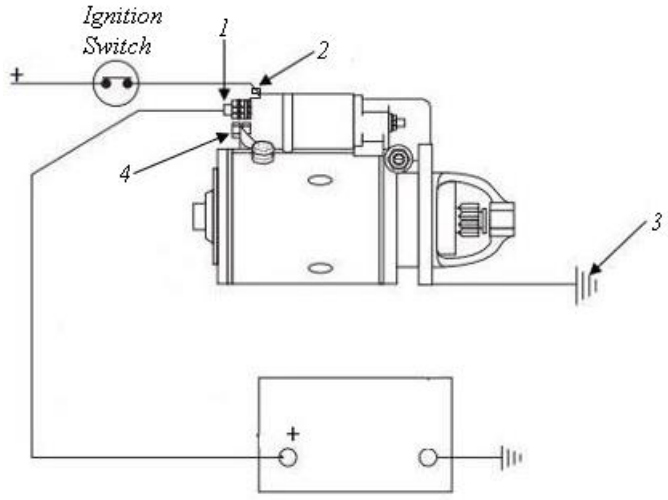
The following figure represents starter motor circuit and the number labeled represents the terminals of the starter motor. Explain a correct connection of the terminal from power source to the starter motor and disconnect the wrong connection to enhance the following action of the starter motor.

(a) (i) To move forth a pinion gear for engagement to the ring gear of the flywheel.

(ii) To allow the main cable to connect power from the source allowing a pinion gear to rotate without moving out.

(iii) To allow the pinion gear to move forth and rotate.

(b) Name the parts labelled with numbers 1-3.



Starter Motor Circuit

A total of 183 (100%) candidates attempted this question whereas 165 (90.16%) scored from 0 to 2.5 mark; 14(7.65%) scored from 3.0 to 5.5 marks; and 4 (2.19%) scored from 6.0 to 9.0 marks. Generally, the majority candidates, 165 (90.16%) performed poorly in this question. This analysis is summarized in Figure 7.

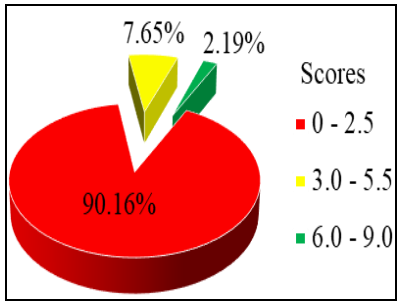
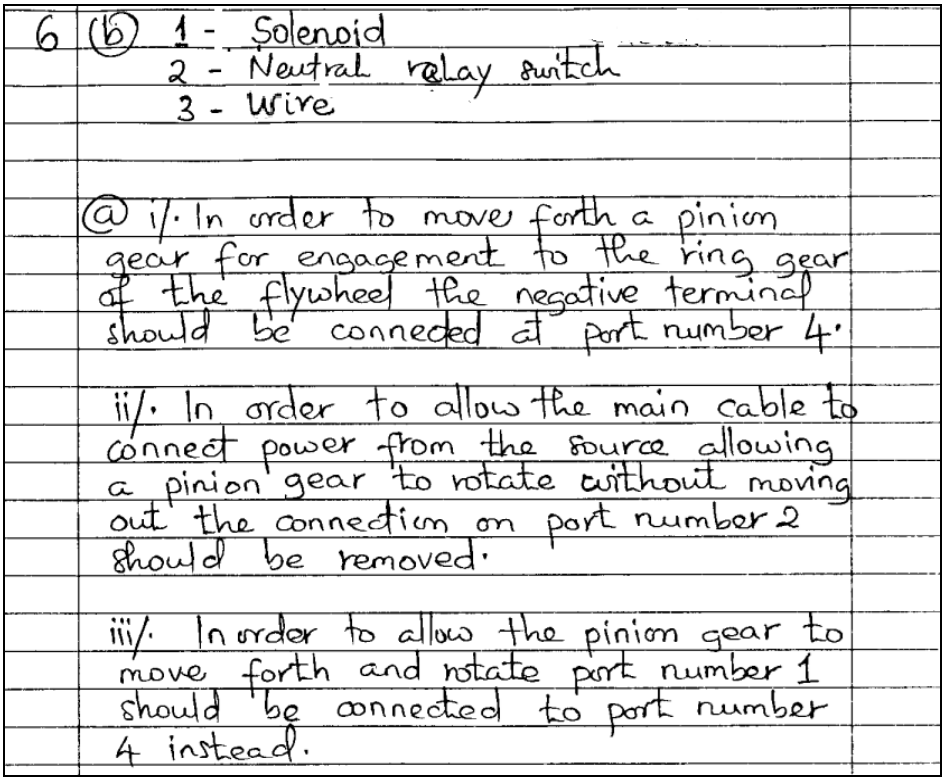


Figure 7: *The Candidates' Performance in Question 6*

Most of the candidates 165 (90.16 %) did not attempted this question correctly. Among them, 52 (28.42%) had responses which were irrelevant to the question asked thus they scored 0 marks. The 106 (57.92%) of candidates had one correct response worth only 1 mark. These candidates managed to only name one out of the required parts 1-3 in part (b). On the other hand, the 7 (3.83%) candidates could name only two parts correctly, out of three parts required thus scored 2 marks. Most of these candidates wrote incorrect answers in part (a) therefore they had weak performance in this question. For example, one candidate answered item (a) as follows; *(i) connected Terminal 1 and terminal 3 in order to move forth a pinion gear for engagement to the ring gear of the flywheel (ii) Connect terminal 4 and terminal 3 in order to allow the main cable to connect power from the source allowing a pinion gear to rotate.* These candidates failed to realize that to develop the action of the starter motor circuit for the situations presented in (i), (ii) and (iii) which is (i) *to move forth a pinion gear for engagement to the ring gear of the flywheel* the correct connection was to connect the positive terminal of the power source to the starter motor terminal marked '2' (for 'start') and were required to connect the negative terminal '3' to the starter motor casing or chassis ground. But were supposed to identify the incorrect connection '1' which was to be disconnected because it was a terminal not directly related to the 'start'

terminal of the starter motor circuit. Furthermore, in (ii) *to allow the main cable to connect power from the source allowing a pinion gear to rotate without moving out* the candidates were required to understand that it was supposed to connect terminal 3 and shift the starter cable from terminal 1 to connect terminal 4. In addition, (iii) *to allow the pinion gear to move forth and rotate* candidate were supposed to understand that pinion gear move forth and rotate when terminal 1, terminal 2 and terminal 3 are connected. These candidates fail to recognize that incorrect connection caused by disconnection or interference with the 2 and 3 terminals, as both are necessary for the proper functioning of the starter motor to move forth and rotate the pinion gear. Malfunction of these terminals or having them improperly connected could prevent the starter motor from engaging or rotating the pinion gear effectively. Extract 6.1 is a sample presenting the candidates' incorrect response.


6 (b) 1 - Solenoid
2 - Neutral relay switch
3 - Wire

(a) i/. In order to move forth a pinion gear for engagement to the ring gear of the flywheel the negative terminal should be connected at port number 4.

ii/. In order to allow the main cable to connect power from the source allowing a pinion gear to rotate without moving out the connection on port number 2 should be removed.

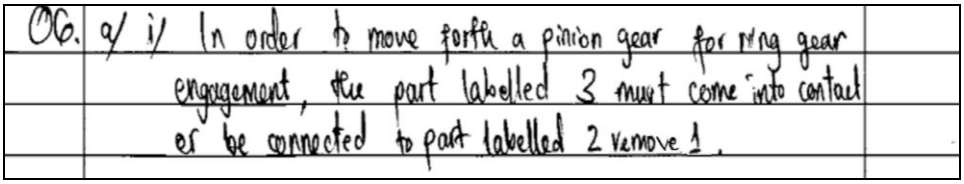
iii/. In order to allow the pinion gear to move forth and rotate port number 1 should be connected to port number 4 instead.

Extract 6.1: A sample of poor responses to Question 6

In Extract 6.1, the candidate failed to explain a correct connection of the terminal from power source to the starter motor and disconnect the wrong connection to enhance the action of the starter motor in part (a). He/she was not able to name the parts labelled with numbers 1-3 in part (b).

Moreover, 7 (6.2%) candidates who got an average marks managed to attempt correctly part (b), but they failed to give accurate explanation in part (a). It seemed they lacked the competence of connecting starter motor terminals hence did not pursue the requirement of the question in part (a). Their responses generally demonstrated a lack of familiarity and technical know-how in the areas of general electrical principles, automobile 'starter motor safety awareness', 'starter motor wiring abilities' 'problem-solving techniques', and finally demonstrated poor attention to starter motor wiring detail.

On the other hand, only 4 (2.19%) candidates performed well in this question. From these candidates, one achieved to score all 9 marks and showed full understanding and adequate knowledge of starter motor and its connection. Extract 6.2 is a sample presenting the correct response of the candidate.


06. a/ i/ In order to move forth a pinion gear for ring gear engagement, the part labelled 3 must come into contact or be connected to part labelled 2 remove 1.

Extract 6.2: A sample of good responses to Question 6

In Extract 6.2, the candidate explained one correct terminal connection from the power source to the starter motor.

2.2.7 Question 7: Maintenance Practice

The question was set from the topic, *Maintenance Practice.* It intended to measure candidates' ability to give disadvantages of preventive maintenance and explain the losses eliminated when employing a Total Productive Maintenance. The question was:

(a) *Preventive maintenance is mostly preferred due to reliability of vehicle. However, it has negative impacts. Give three disadvantages.*

(b) *Automotive workshop manager is likely to employ Total Productive Maintenance (TPM) in performing different tasks in the workshop. What are the types of losses a workshop manager tried to eliminate at the workshop? Give three types.*

The analysis indicates that, 183 (100%) candidates attempted this question. Among them, 19 (10.38%) candidates scored from 0 to 2.5 marks, 9 (4.92%) candidates scored zero. Moreover, 59 (32.24%) of the candidates scored from 3.0 to 5.5 marks and 105 (57.38%) of the candidates scored from 6.0 to 9.0 marks. The majority of the candidates, 164 (89.62%) performed well this question by scoring average and above. Therefore, the general performance of the candidates in this question was good. Figure 8 illustrates this performance.

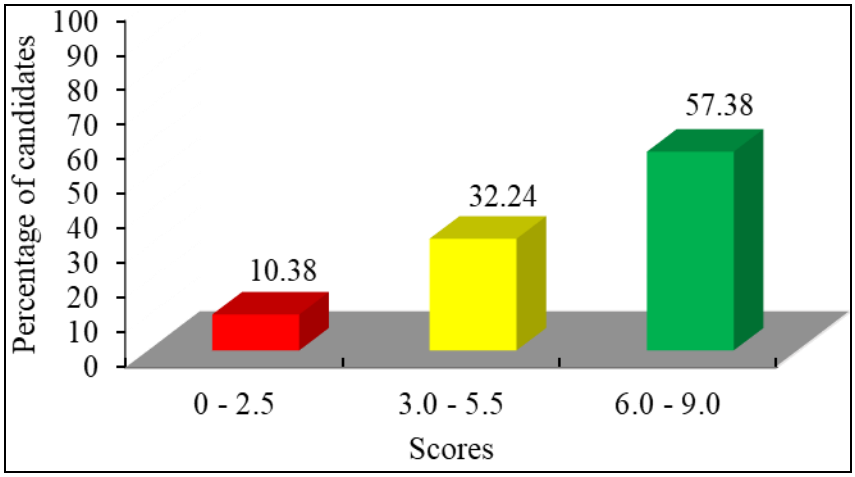
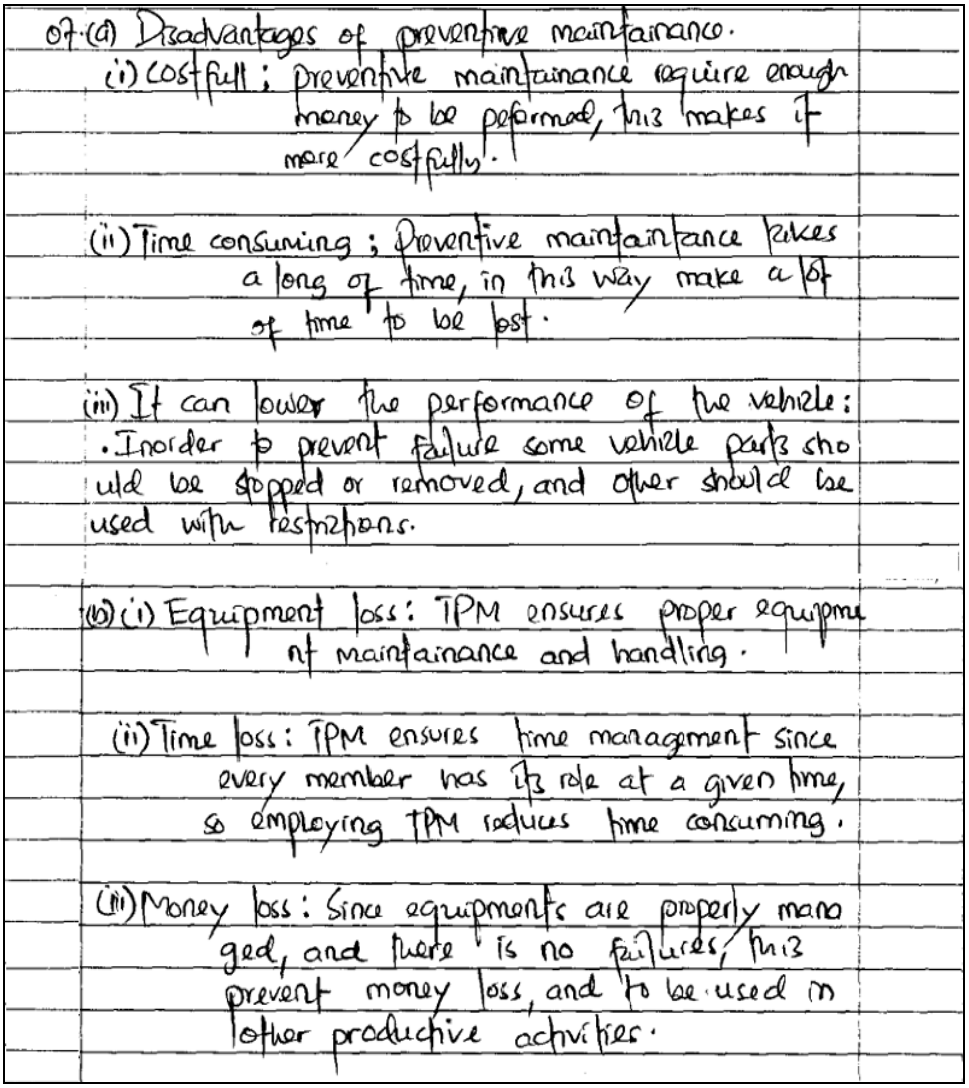


Figure 8: *The Candidates' Performance in Question 7*

The candidates who had good performance had enough knowledge related to the concepts of preventive maintenance and total productive maintenance in part (a) and (b) respectively. Furthermore, 34 (18.58%) who scored all marks were able to give correctly the three disadvantages of preventive maintenance in part (a) and in part (b) managed to give all three losses that an automotive workshop manager aimed to eliminate at work during implementation of Total Production

Maintenance. One candidate he/she wrote in part (a) that, *(i) Implementing preventive maintenance measures can incur significant costs (ii) preventive maintenance increase unwanted downtime* and *(iii) Sometime the quality preventive maintenance is which lead to breakdown.* Furthermore, this candidate answered part (b) as *the three types of losses workshop manager tried to eliminate are; (i)time saved of maintenance period (ii) escape unplanned maintenance* and *(iii) prohibit Losses due to Performance Efficiency.*

The candidates who scored all 9 marks had adequate knowledge and skills and also possessed a strong understanding of maintenance principles, including the concepts of preventive maintenance and Total Productive Maintenance (TPM). However, some candidates did not write all three of the disadvantages of preventive maintenance in part (a) and only recorded some of the three losses the workshop manager was attempting to prevent by introducing TPM in part (b). As a result, they scored a high, but less than the 9 marks that was allocated for this question. Extract 7.1 is a sample of good responses to question 7.


07. (a) Disadvantages of preventive maintainance.
(i) Costfull; preventive maintainance require enough money to be peformed, this makes it more costfully.

(ii) Time consuming; Preventive maintaintance takes a long of time, in this way make a lot of time to be lost.

(iii) It can lower the performance of the vehicle:
. Inorder to prevent failure some vehicle parts should be stopped or removed, and other should be used with restrictions.

(b) (i) Equipment loss: TPM ensures proper equipme nt maintainance and handling.

(ii) Time loss: TPM ensures time management since every member has its role at a given time, so employing TPM reduces time consuming.

(iii) Money loss: Since equipments are properly mana ged, and there is no failures, this prevent money loss, and to be used in other productive activities.

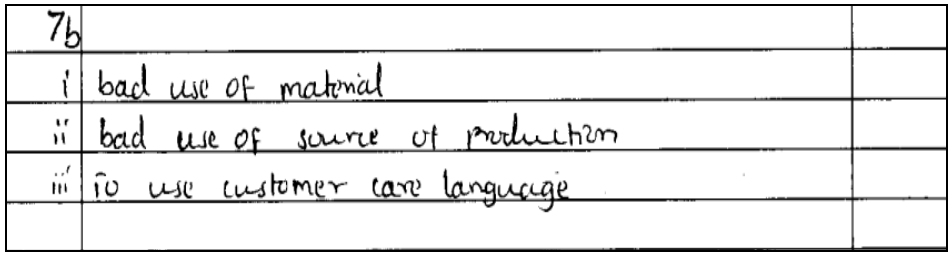
Extract 7.1: A sample of good responses to Question 7

Extract 7.1 shows a sample of good responses from the candidate who managed to answer correctly parts of (a) and (b).

On the other hand, 59 (32.24%) of the candidates who scored average marks in this question were able to answer some parts of (a) and (b) by providing fewer points than the question demand. For example, one candidate seemed to answer accurately the question in part (a) and failed to attempt the question in part (b). This candidate confused the types of losses that could be prevented by employing Total Productive

Maintenance (TPM) in the workshop. He/she wrote irrelevant response in this part as; *(i) Total productive maintenance will increase production,* instead of writing the losses that could be prevented he/she wrote one of a sort of advantage of employing Total productive maintenance thus scored average score. Some of the candidates who attempted this question managed both part (a) and (b) partially. Others attempted correctly part (a) but failed part (b) and vice versa thus all of them ended up scoring mediocre.

Further analysis showed that, the candidates who scored 0 lacked fundamental understanding of maintenance principles, including preventive maintenance in part (a) and were not conversant with the types of losses in the workshop that could eradicated through employing Total Productive Maintenance (TPM) in part (b). For example, one candidate wrote in part (b) as; *(i) can eliminate the efficiency (ii) can eliminate laziness in the workshop (iii) less quality of production*. In general, this indicated gaps in their knowledge of maintenance strategies and their importance in ensuring equipment reliability and productivity. Furthermore, in part (a) they did not know that over maintenance, maintenance cost, vehicle downtime and disruption to operations were disadvantages of preventive maintenance. In addition, in part (b) they were not able to give the three types of losses a workshop manager tried to eliminate at the workshop by employing TPM. They had no clue that losses that TPM aimed to eliminate at work were down time losses caused by unexpected break down of vehicle, speed losses caused by technician who spend longer time to fix a minor break down of vehicle and defective losses raised from poor quality of spare. Extract 7.2 shows a sample of poor to question 7.



Extract 7.2: A sample of poor responses to Question 7

Extract 7.2 shows a sample of poor responses from the candidate who was not able to answer correctly parts of (a) and (b).

2.2.8 Question 8: Mechanical Engineering Jobs and Occupations

The question was set from the sub-topic, The Importance of Mechanical Engineering Field in a Society. It intended to measure candidates' ability identifying mechanical engineering job opportunities in the society, and analyses the contributions of mechanical engineering fields in the socio-economic development. The question was:

The question was set from the sub-topic, *The Importance of Mechanical Engineering Field in a Society*. It intended to measure candidates' ability to identify mechanical engineering job opportunities in the society, and analyze the contributions of mechanical engineering fields in the socio-economic development. The question was:

In six points, "explain the importance of mechanical engineering in the society".

A total of 183 (100%) candidates attempted this question from which 4 (2.19%) candidates scored from 0 to 2.5 mark; 3 (1.64%) scored from 3.0 to 5.5 marks; and 176 (96.17%) candidates scored from 6.0 to 9.0 marks. The majority of the candidates (97.81%) scored average and above. Figure 9 presents scores with respect to the percentage of the candidates.

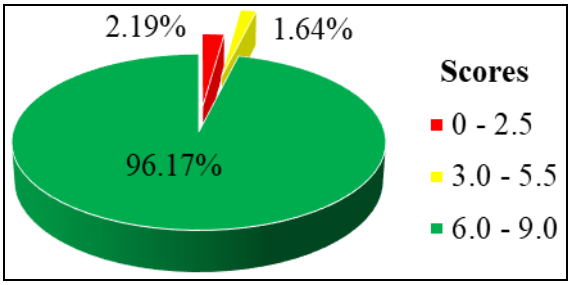
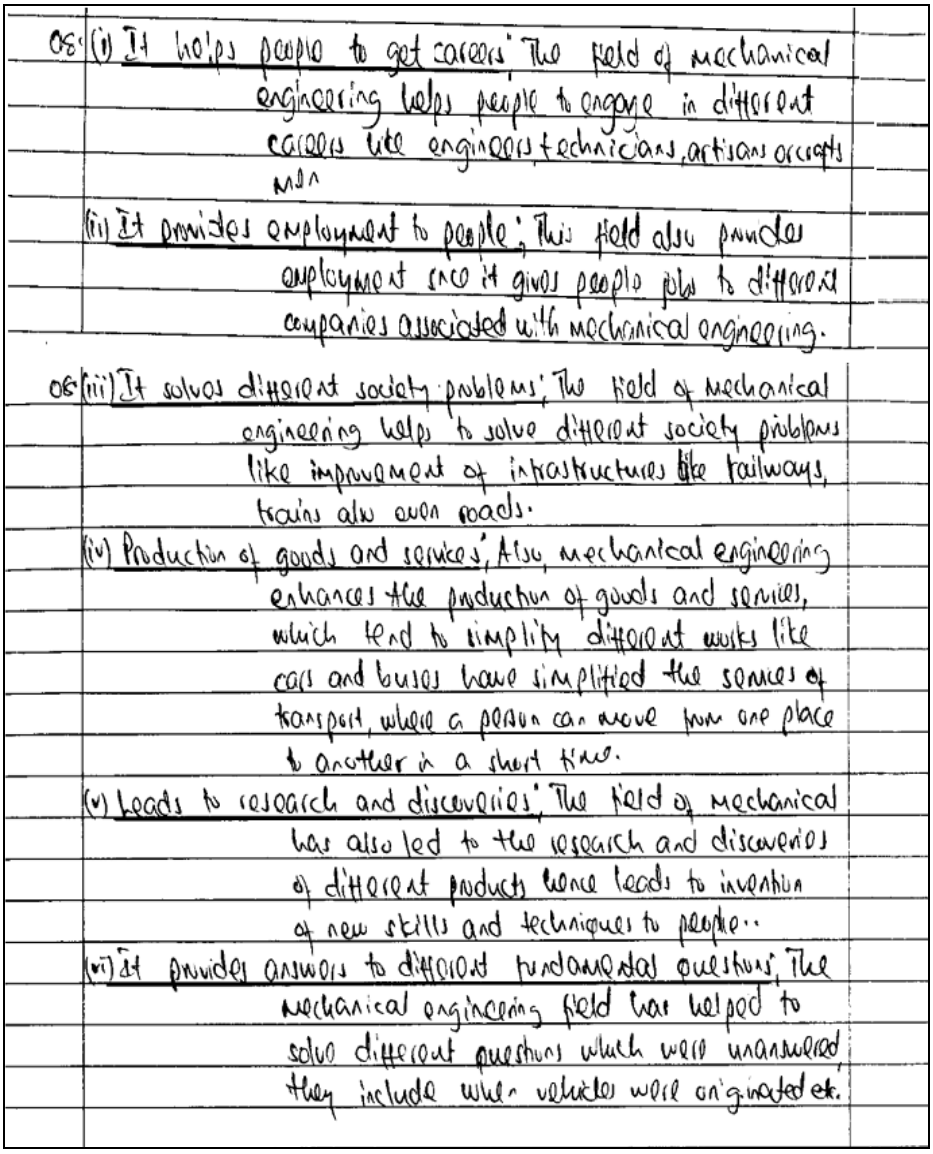


Figure 9: *The Candidates' Performance in Question 8*

Most of the candidates, 159 (96.17%) who scored from 6.0 to 9.0 marks got 9 marks. These were able to identify mechanical engineering job

opportunities in the society. They were also able to analyse the contributions of mechanical engineering fields in the socio-economic development. They were able to explain the six points on the importance of mechanical engineering that the field of mechanical engineering encourages innovation by creating new technologies and refining old ones, which aids in technological advancement. They were able to state that the field is essential to the advancement of society since it designs and builds machines, automobiles, and other mechanical systems that increase productivity and efficiency across a range of industries. They also stipulated that Mechanical engineers contribute significantly to infrastructure development by assisting in designing and constructing buildings, bridges, roads, and transportation systems. They ensure the safety, reliability, and sustainability of these structures, which are vital for economic growth and societal well-being. In addition to promote innovation and infrastructural growth, they were also able to respond that mechanical engineers play a big role in energy production, distribution, and conservation.

Additionally, candidates highlighted the significance of mechanical advancement in the fields of healthcare and biomedical engineering, environmental sustainability, and economic growth. Some candidates scored well, but not quite 9 marks. These candidates seemed to have excellent knowledge about the importance of mechanical engineering field. These were able to write on the importance of mechanical engineering to society, but they acquired fewer than six points, which caused them to be awarded fewer than 9 marks. The aforementioned candidates seemed to have a diverse range of competencies in the fields of technical knowledge, problem-solving ability, communication skills, and critical thinking. Extract 8.1 is the sample of good responses to Question 8.



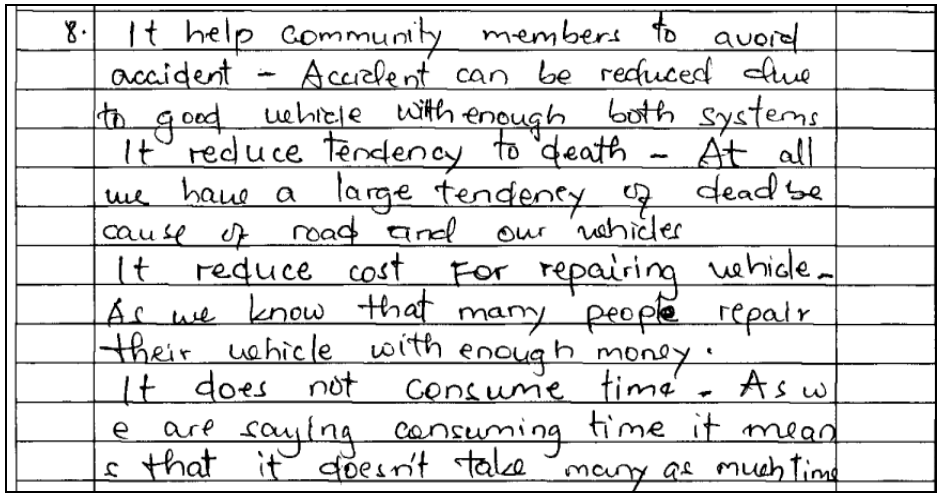
Extract 8.1: A sample of good responses to Question 8

Extract 8.1 shows a sample of the responses from the candidate who provided correct answers. He/she managed to write six points to explain the importance of mechanical engineering in the society.

Since most candidates had good results, only three (1.64%) candidates scored average marks. These candidates were not able to write all points to explain the importance of mechanical engineering in society.

Instead, one candidate explained correctly only two points and the other two explained three points as a result they achieved mediocre. These candidates had mechanical technical knowledge deficiency, since they did not show understanding of complete engineering concepts and how they are used in practical situations. This lack of knowledge of technical matters made it difficult for them to explain completely all six points how important mechanical engineering is for advancing technological innovation and solving societal problems.

Apart from those who scored good and average, there were few 4 (2.19%) candidates who failed and scored below average. Two candidates among them did not make it to write any points regarding explanation of the importance of mechanical engineering in society thus they scored zero. Others wrote one point and scored weak marks. For example, one candidate wrote one point as *it does not consume time* without any explanation therefore scored zero. In general, the candidates who were unable to articulate the importance of mechanical engineering to society lacked the needed technical knowledge on the; abilities to communicate, impact of mechanical engineering on society awareness, ability to connect theory and practice with regard to mechanical engineering and exposure to industry. Extract 8.2 shows a sample of poor responses.


8. It help community members to avoid accident - Accident can be reduced due to good vehicle with enough both systems
It reduce tendency to death - At all we have a large tendency of dead be cause of road and our vehicles
It reduce cost for repairing vehicle - As we know that many people repair their vehicle with enough money.
It does not consume time - As we are saying consuming time it means that it doesn't take many as much time

Extract 8.2: A sample of poor responses to Question 8

Extract 8.2 shows a sample of poor responses from the candidate who wrote irrelevant points to explain the importance of mechanical engineering in the society.

2.3 SECTION C: Structured Questions

2.2.9 Question 9: Automobile Engine Technology

This question was set from the topic, *Automobile Engine Technology*. It intended to measure the candidates' competence in analysing compression ignition against spark ignition engines with respect to heavy duty vehicles and two stroke spark ignition engine against four stroke spark ignition engine with regard to two wheels' cycles. The question was:

(a) Mostly heavy duty vehicles are designed with compression ignition engines rather than spark ignition engines. Justify the statement by giving five reasons.

(b) Why is two stroke spark ignition engine mostly preferred in two wheels than four stroke spark ignition engine? Give five reasons.

This question was attempted by 180 (98.36%) candidates from which 21 (11.67%) candidates scored from 0 to 4.0 marks; 70 (38.89%) scored from 4.5 to 9.5 marks; and 89 (49.44 %) scored from 10.0 to 15.0 marks. The majority of the candidates, 159 (88.33%) scored average and above. Figure 12 summarizes the candidates' performance in this question.

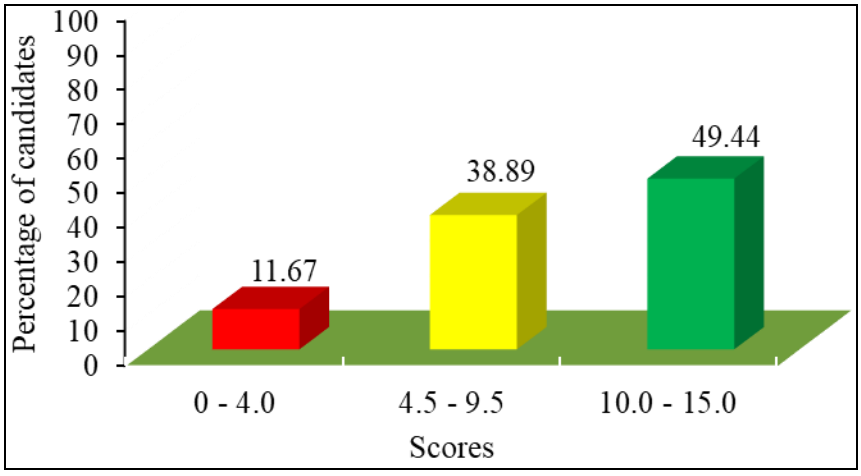


Figure 10: *The Candidates' Performance in Question 9*

The analysis show that, the 9 (5%) candidates who scored all the 15 marks were able to give five reasons for heavy duty vehicles to be designed with compression ignition engines rather than spark ignition engines in part (a). In part (b), the given candidates succeeded to give five reasons as why is two stroke spark ignition engine mostly preferred in two wheels than four stroke spark ignition engine. This group of candidate was conversant with the concept of application of *compression ignition engines, spark ignition engines, two stroke spark ignition engine and four stroke spark ignition engine.* For example, one candidate wrote in part (a) that, *the advantages of compression ignition engine as compared with the spark ignition engine as compression ignition engines have; high compression ratio, longer intervals between overhauls than spark ignition engine. Also he/she wrote that compression ignition engines has; reliable and stable volumetric efficiency, high thermal efficiency and high expansion ratio than spark ignition engine.* This group of candidates seemed had strong understanding on internal combustion engine principles, including the differences between compression ignition and spark ignition engines, as well as the characteristics and advantages of two-stroke and four-stroke engine designs.

Besides, despite of those who achieve to score full marks, there were those who scored high but less than 9 marks. These candidates managed to answer correctly the question but made slight mistake of either giving some few wrong reasons or did not write some reasons in part (a) or (b). For example, one candidate attempted part (a) correctly by giving five reasons as why heavy duty vehicles are designed with compression ignition engines rather than spark ignition engines but wrote less than five reasons required in part (b) as a result ended up scoring high but less than 9 marks allotted to this question. These candidates seemed to have enough knowledge but either by being careless and not writing all the reasons in part (a) and (b) or by not remembering some of the reasons, it led them into writing only a few reasons. Extract 9.1 is a sample of good responses of Question 9.

09. a) Mostly heavy duty vehicles are designed with compression ignition engines rather than spark ignition engines because of the following reasons;

(i) Higher compression ratios. In compression ignition (CI) engines they tend to be produce greater ratios of compression than the spark ignition (SI) engines.

(ii) Higher power output. The CI engines produce greater power outputs as they produce greater ratios of compression than the SI engines which produce low ratios of compression hence low power output.

(iii) Higher efficiency. The CI engines having greater power outputs and compression ratios tend to have a greater efficiency compared to the SI engines having a lower efficiency.

(iv) Increased engine life expectancy. The CI engines do not suffer relatively complications of failure hence the engines in CI engines tend to have greater life expectancy than the SI engines.

(v) Reduced rate of failures. The CI engines use the heat of compression to ignite the mixture of air and fuel and so, it does not encounter several failures like misfiring and defective plugs as it does not use plugs to ignite the mixture as how the SI engines work.

Extract 9.1: A sample of good responses to Question 9

In Extract 9.1, the candidate correctly wrote five reasons as why heavy duty vehicles are designed with compression ignition engines rather than spark ignition engines in part (a). In part (b) he/she managed to write five reasons as why two stroke spark ignition engine mostly preferred in two wheels than four stroke spark ignition engine.

The 70 (38.89%) candidates who performed averagely were able to answer correctly some parts of the question. The analysis shows that, most of them answered partially part (a) and correctly part (b) while others answered only part (b). Few other candidates mixed up by

confusing the properties of the compression and spark ignition engine and two and four stroke engine, thus ended up with average marks.

For example, one of his/her reason in part (a) the candidate wrote; *compression ignition engine produces less torque than spark ignition engine.* In part (b), this candidate wrote *two stroke spark ignition engine has fewer moving parts than four stroke spark ignition engine.* Most of these candidates had limited knowledge and skills with regard to internal combustion engine principles, including the differences between compression and spark ignition engines, as well as the characteristics and advantages of two-stroke and four-stroke engine designs. Further analysis reveal that, these candidates partially were familiar with engineering principles related to engine design of two and four stroke engine, their performance, and efficiency. This knowledge could allow them to analyze the advantages and disadvantages of various engine configurations and suggest the most appropriate reasons for referring certain type of engine configurations for specific purpose.

The few candidates, 6 (3.33%) who scored 0 mark were not able to answer correct any part of the question. Therefore, they could not reason and write as why most of heavy duty vehicles are designed with compression ignition engines rather than spark ignition engines in part (a) and in part (b). These candidates failed to give the five reasons for the two-stroke spark ignition engine to be preferred in two wheels than four-stroke spark ignition engine. For example, one candidate wrote incorrect answer in part (a) such as *(i) it has low thermal efficiency than spark ignition* and *(ii) It has small expansion ration than spark ignition engine.* The analysis carried out on their responses suggested that, these candidates did not acquire the necessary skills and competences in compression and spark ignition engines, as well as the designs of two and four-stroke engine. Further analysis reveals that, 15 (8.33%) candidates wrote a few responses because they had limited knowledge, something made them to score below average. For example, some give only one or two reasons in part (a) or (b) thus scored weak scores. Extract 9.2 is a sample of poor responses to Question 9.

9a	compression ignition engine- This are the engine which use the ~~oil~~ diesel to start the engine so in another word we can say this is diesel engine.
	The following are reason of using compression engine on heavy duty
i	It have high power- The compression engine it have a high power and this make the compression engine to be usen in heavy duty.
ii	It use air ~~to~~ to ignite the fuel- The compression engine use air to ignite the fuel rather than spark ignition engine which use plug to ignite the mixture of fuel + air
iii	It use diesal for fuel- compression engine used the diesal as the fuel and diesal have high quality power and this make the compression engine to be usen in heavy ~~fuel~~ duty.
iv	It occupies more space- The compression engine occupies more space due to the heavy metal which are used in manufacture of the compression engine.
v	It use heavy flywheel- The compression engine use heavy flywheel this is ~~to~~ due to heavy duties that is goes to perform.

Extract 9.2: A sample of poor responses to Question 9

Extract 9.2 shows that, the candidate failed to give correct answers in all parts of the question. He/she was not able in part (a) to give reasons on why heavy duty prefers compression ignition engines rather than spark ignition engines. Moreover, he/she failed to attempt part (b).

2.2.10 Question 10: Refrigeration and Air Conditioning

The question was set from the topic of *Refrigeration and Air Conditioning*. It intended to measure the candidates' ability and competence in repairing and servicing air conditioning system. The question was:

Suppose you are instructed to fix leakage in air conditioning system. Before fixing the leakage;

(a) *identify three colors of tube and their connection to the manifold gauge.*

(b) *briefly explain eight places where a quick visual inspection can be carried out to ensure better performance of air conditioning system.*

The question was attempted by 37 (20.22%) candidates from which 19 (51.35%) scored from 0 to 4 marks; 14 (37.84%) scored from 4.5 to 9.5 marks; and only 4 (10.81%) scored from 10 to 15 marks. The overall performance of this question was average, since 18 (48.65%) of the candidates scored average and above. Figure 13 summarizes the candidates' performance in this question.

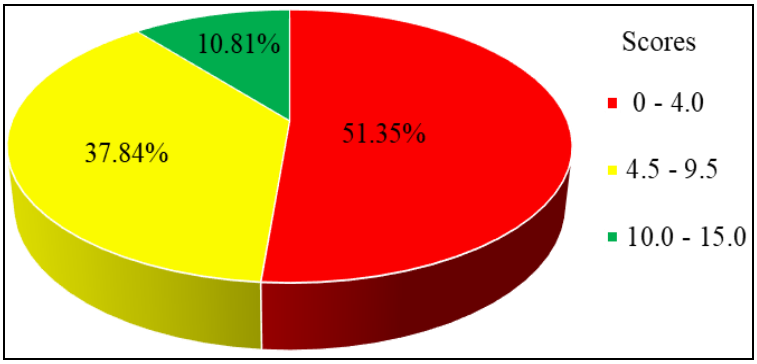
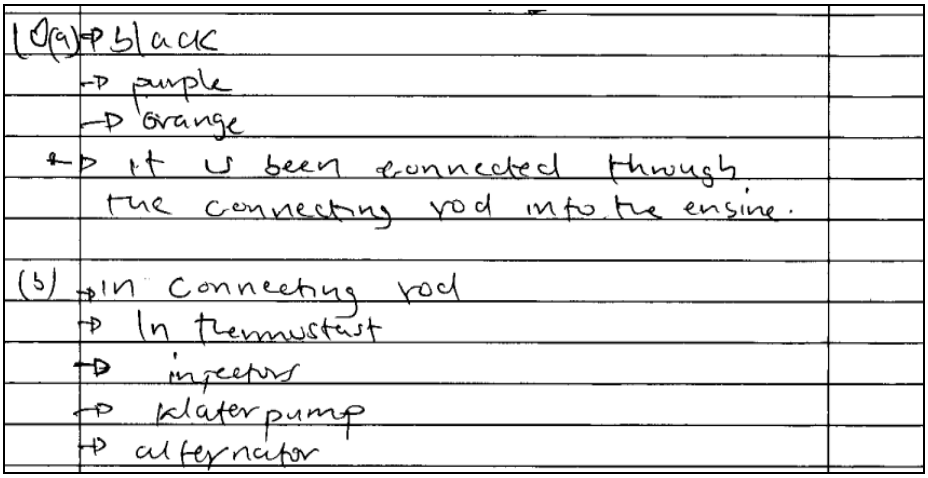


Figure 11: *The Candidates' Performance in Question 10*

It was observed that, the candidates who scored 0 mark were not familiar with air conditioning system. These candidates failed even to identify three colors of tube with their port. In part (a) the candidates were not aware that, the three colours of tubes with their respective port of connection is Red tube which is connected to high-pressure port on the manifold gauge, blue tube which is connected to low-pressure port on the manifold gauge and yellow tube which is a refrigerant hose and it is connected to center port or refrigerant tank. Furthermore, the candidates did not understand that eight places where a quick visual inspection would be carried out to ensure better performance of air conditioning system are condenser coil, evaporator coil, setting of thermostat and functionality, refrigerant lines and compressor pulley

cracks. In addition, they did not recognize that identifying potential issues before they deteriorate require costly repairs. Performing these quick visual inspections at these points could help to ensure better performance and efficiency of the air conditioning system. Despite of the candidates who scored 0 in this group, there were 9 (24.32%) who had weak performance as they scored from 1 to 4 marks. Most of these candidates provided few correct answers in part (b) but none of them achieved some marks in part (a). For example, one candidate wrote in part (b) as *(i) condenser parts and (ii) evaporator pipes* and he/she ended up scoring weak scores. Extract 10.1 shows a sample of the poor responses.



Extract 10.1: A sample of poor responses to Question 10

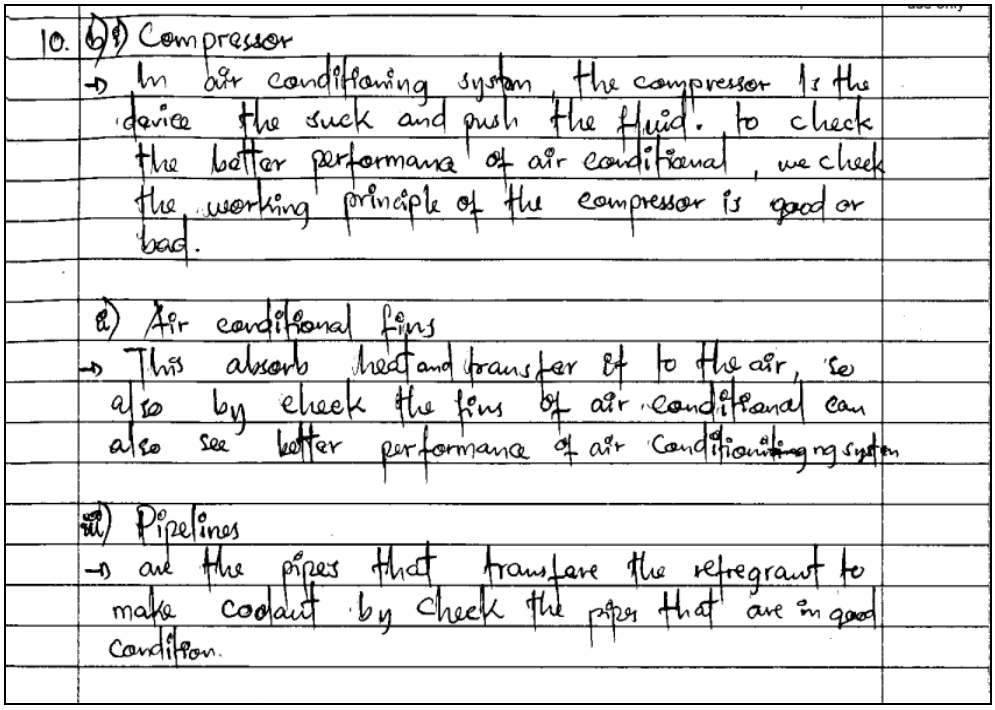
Extract 10.1 shows that, the candidate failed to identify three colors of tube and their connection to the manifold gauge in part (a) and in part (b). He/she was not able to explain eight places where a quick visual inspection could be carried out to ensure better performance of air conditioning system as a result they scored 0.

The candidates, 14 (37.84%) who had average performance were only able to explain eight places for quick visual inspection in part (b) but failed to identify the three colors of tube and their connection in part (a). Others answered partially in both parts of the question hence achieved to score averagely. For example, one candidate was able to

write one colors of tube as; *yellow line* in (a) and few places for visual inspection in air conditioning in part (b) therefore he/she scored average scores. Others wrote partially answers in both parts of the question therefore ended with average score as well.

The analysis shows that, only 1(2.70%) of the candidates who scored all 15 marks was conversant with air conditioning system. This candidate identified the three colors of tube with their port. In part (a), he/she knew that the three colours of tubes with their respective port of connection were red, blue and yellow tubes which are connected to high pressure port, low pressure port and refrigerant tank respectively. Moreover, the candidate comprehended and wrote all eight parts of air conditioner for a visual check-up required in part (b). In addition, he/she knew that doing inspections at these air conditioning components could ensure better performance and efficiency of the system before they deteriorate and require costly repairs.

Despite of the candidate who scored 15 in this category, 3 (8.11%) candidates had good performance as they scored between 10 and 14 marks. All of them made slight error in identify three colors of tube and their connection to the manifold gauge in part (a) and in part (b) for explaining eight parts of air conditioner required for quick check-ups thus ended up scoring high but less than 15 marks. In general, the responses provided by these candidates demonstrated a complete comprehensive understanding of air conditioning system components, maintenance practices, and troubleshooting techniques important for ensuring better air conditioning performance and efficiency. Extract 10.2 is an example of a good response to this question.


10. b) i) Compressor
→ In air conditioning system, the compressor is the device the suck and push the fluid. to check the better performance of air conditional, we check the working principle of the compressor is good or bad.

ii) Air conditional fins
→ This absorb heat and transfer it to the air, so also by check the fins of air conditional can also see better performance of air conditioning system

iii) Pipelines
→ are the pipes that transfare the refregrant to make coolant by check the pipes that are in good condition.

Extract 10.2: A sample of good responses to Question 10

Extract 10.2 shows that, the candidate answered correctly part of this question. In part (b), he/she managed to explain some parts of air conditioning where a quick visual inspection could be carried out to ensure better performance of air conditioning system.

2.2.11 Question 11: Power and Energy

This question was set from the topic, *Power and Energy*. It intended to measure the candidates' competence in identifying and explaining energies conventions, which assist in transferring the power from the engine to the road wheel and stopping the car. The question was:

Different energies convention is achieved to insure that motor car is either running or stopping. In five points, explain energies conventions, which assist in transferring the power from the engine to the road wheel and stopping the car.

The analysis shows that, only 149 (81.42%) candidates attempted this question from which 86 (57.72%) candidates scored from 0 to 4 marks;

28 (18.79 %) scored from 4.5 to 9.5 marks; and 35 (23.49%) scored from 10 to 15 marks. The majority of the candidates (57.72%) scored below average. The analysis of candidates' scores is summarized in Figure 12.

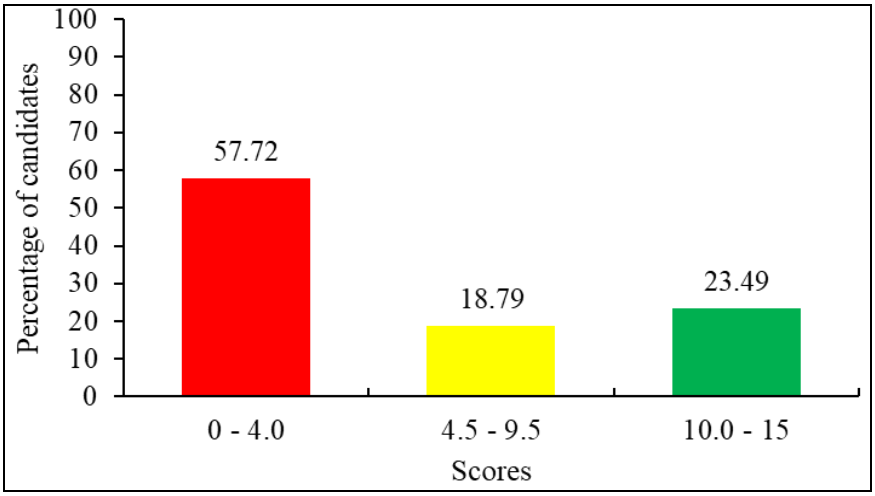
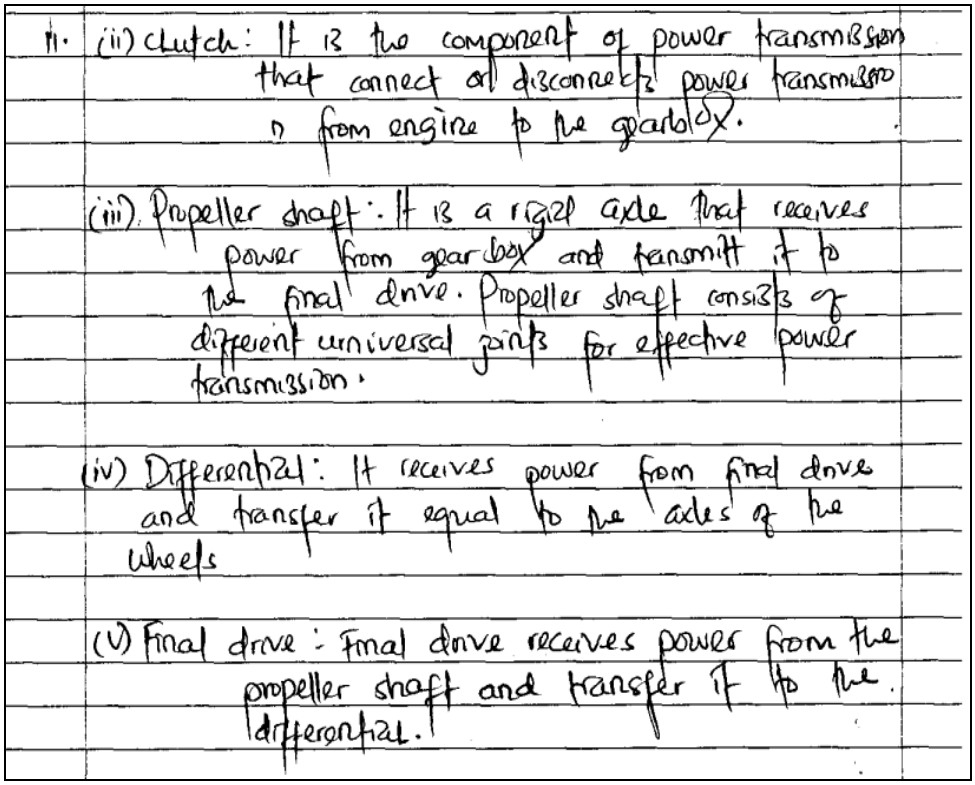


Figure 12: *The Candidates' Performance in Question 11*

The analysis shows that, 86 (57.72%) of the candidates scored 4 marks or less among them, 63 (42.28%) scored 0 mark. These candidates lacked sufficient knowledge on the topic of Power and Energy. These candidates were not able to explain the energies converted to transfer the power from the engine to the road wheel and energy employed in stopping the car. The candidates did not know that combustion process, power transmission, applying the brake, starting system and charging system all of them involve energy conversion for their work done to be employed effectively. These candidates lacked a comprehensive understanding of vehicle operation, mechanical systems and energy conversion processes.

On the other hand, some candidates in this group scored weak marks. All of them provided one correct answer worth 3 marks thus ended up with weak scores. They provided different responses such as *the mechanical energy produced from alternator to produce electricity, starting electrical energy converted to mechanical energy to crank the engine* and *Power transmission from the engine operation to the wheel.*

Moreover, some of the candidates provided other wrong answers such as, *battery to manage light at night* and *changing of different vehicle speed with the application of gearbox.* Others did not understand the requirement of the question as they mistakenly described different parts of engine parts. Extract 11.1 shows a poor response from one of the candidates.


11. (ii) Clutch: It is the component of power transmission that connect or disconnects power transmission from engine to the gearbox.

(iii) Propeller shaft: It is a rigid axle that receives power from gearbox and transmitt it to the final drive. Propeller shaft consists of different universal joints for effective power transmission.

(iv) Differential: It receives power from final drive and transfer it equal to the axles of the wheels

(v) Final drive: Final drive receives power from the propeller shaft and transfer it to the differential.

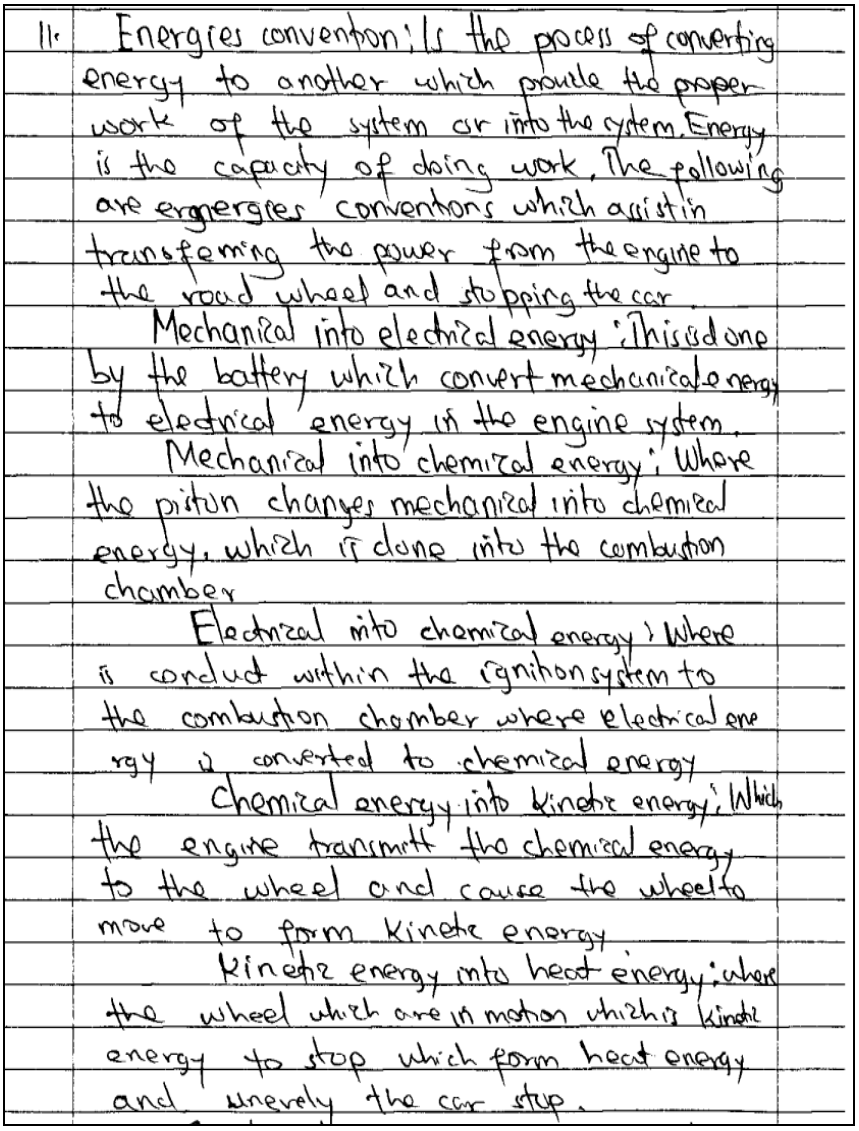
Extract 11.1: A sample of poor responses to Question 11

In Extract 11.1, the candidate was not able to explain about energies conventions, which assist in transferring the power from the engine to the road wheel and stopping the car.

Most of the candidates who performed averagely 28 (18.79%) candidates who performed averagely did not provide all five conversion of energies as was required in the question. Some of them wrote three points while others wrote only two points hence achieved average performance. However, some of the candidates wrote more than five points to explain energies conventions which assist in transferring the

power from the engine to the road wheel and stopping the car, it was either three or two points were correct ones thus they ended up scoring average scores. From their responses it was verified that the candidates from this group had partial knowledge concerning energies conversion in a motor car.

The analysis shows that, 30 (20.13%) of the candidates scored all 15 marks. These candidates had sufficient knowledge on the conversion of energies in motorcar. They were able to explain most of conversion of energies from motorcar such as mechanical energy from charging system, energies in the combustion process, power transmission energy from the engine operation to the wheel, cranking energy from starting system and frictional energy conversion between brake shoes and drum. Among them, there were only 5 (3.36%) who scored 12 mark. These candidates explained four points of the energies converted to transfer the power from the engine to the road wheel and energy employed in stopping the car. Their explained points revealed that, they had adequate knowledge with regard to energies conversion in motorcar but made slight mistake by mentioning one wrong point when they were jotting down the source of energy to be converted from one type of energy to another. Therefore, they scored high but less than 15 marks. Extract 11.2 is a sample of the candidate's responses who performed well in this question.


11. Energies conventon; Is the pocess of converting energy to another which proule the proper work of the system or into the system. Energy is the capacity of doing work. The following are ergnergies conventons which assist in transfeming the power from the engine to the road wheel and stopping the car.

Mechanical into electrical energy; This is done by the battery which convert mechanical energy to electrical energy in the engine system.

Mechanical into chemical energy; Where the piston changes mechanical into chemical energy, which is done into the combustion chamber

Electrical into chemical energy; Where is conduct within the ignition system to the combustion chamber where electrical energy is converted to chemical energy

Chemical energy into kinetic energy; Which the engine transmitt the chemical energy to the wheel and cause the wheel to move to form kinetic energy

Kinetic energy into heat energy; where the wheel which are in motion which is kinetic energy to stop which form heat energy and unevely the car stop.

Extract 11.2: A sample of good responses to Question 11

In Extract 11.2, the candidate managed to explain about energies conventions, which assist in transferring the power from the engine to the road wheel and stopping the car.

3.0 THE CANDIDATES' PERFORMANCE ANALYSIS IN EACH TOPIC

The analysis of performance in the topics tested in the Automotive Engineering subject for the year 2023 indicates that, the candidates performed well in seven topics, average in three topics, and poor in one topic.

The candidates demonstrated good performance in the topic of *Mechanical Engineering Jobs and Occupations* (97.81%); *Tools and Equipment* (94.54%); *Automotive Systems II (Braking System) (*94.54%); *Maintenance Practice (*89.62%)*; Engine Systems* (88.52%); *Automobile Engine Technology (*88.33%); *Multiple choice (Automotive Electric System, Automotive Systems I (Gearbox), Automotive Systems II (Steering System, Tyres, Braking Systems), Refrigeration and Air Conditioning, Engine Systems (Charging System) Tools and Equipment*) (86.89%). Furthermore, the topics in which the candidates performed averagely were *Automotive Systems I (The Clutch)*(64.48%); *Refrigeration and Air Conditioning* (48.65%) and *Power and Energy* (42.28%). On the other hand, the topic which the candidates performed poorly was *Automotive Electric System (Repair and Maintenance of Auto-Electric System),* 18 (9.84%).

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

The performance of the candidates on the Certificate of Secondary Education Examination (CSEE) in Automotive Engineering subject was good. Despite having a good performance, the candidates encountered some challenges in answering various questions in Automotive Engineering subject. These challenges included lack of adequate knowledge on the concepts in responding to some of the questions, lack of functions of various motorcar components particularly in the topic of *Automotive Electric System (Repair and Maintenance of*

Auto-Electric System), and some candidates' failure in understanding the requirements of the questions.

4.2 Recommendations

Based on the weaknesses observed during analysing candidates' responses, the following are therefore recommended:

(a) Students should:

(i) practise more on application of various maintenance tool in different topics taught in Automotive Engineering subject.

(ii) do more practical works in dismantling and assembling different components and the engine at large so as to experience and understand various motor vehicle and engine components.

(iii) practise diagnosis process in checking liability of different motor vehicle components and experiencing source of malfunctioning of a certain component.

(b) Teachers should guide students on:

(i) doing more practice on how to connect the terminal from power source to the starter motor and disconnect the wrong connection to enhance the action of the starter motor.

(ii) doing more practice on how to fixing the leakage in air conditioning of a motor vehicle.

Appendix

A Summary of Candidates' Performance (Question-Wise) in Automotive Engineering

S/N	Topic	Performance For Each Topic		Remarks
		Question Number	Percentage of Students who Scored 30% or More	
1.	Mechanical Engineering Jobs and Occupations	8	97.81	Good
2.	Tools and Equipment	3	94.54	Good
3.	Automotive Systems II (Braking System)	5	94.54	Good
4.	Maintenance Practice	7	89.62	Good
5.	Engine Systems	4	88.52	Good
6.	Automobile Engine Technology	9	88.33	Good
7.	Automotive Electric System, Automotive Systems I (Gearbox), Automotive Systems II (Steering System, Tyres, Braking Systems), Refrigeration and Air Conditioning, Engine Systems (Charging System), Tools and Equipment	1	86.89	Good
8.	Automotive Systems I (The Clutch)	2	64.48	Average
9.	Refrigeration and Air Conditioning	10	48.65	Average
10.	Power and Energy	11	42.28	Average
11.	Automotive Electric System (Repair and Maintenance of Auto-Electric System)	6	9.84	Weak