2024 NATIONAL SENIOR CERTIFICATE (NSC)

DIAGNOSTIC REPORT

BOOK 3

Empowering Education Through Solidarity, Championing Equality, and Building a Sustainable Future Together.

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

MTN

Read to Lead
A Reading Nation is a Leading Nation

2030 NDP

CONTENTS

CHAPTER 1

INTRODUCTION

FOREWORD

It is with great pride and immense joy that I present the 2024 National Senior Certificate (NSC) Diagnostic Report. The results of the October/November 2024 examinations mark a significant milestone, reflecting not only the culmination of years of hard work, perseverance, and resilience by our learners, but also the steadfast commitment of teachers, parents, and communities across the nation. In a year that presented its own unique challenges, the 2024 cohort demonstrated extraordinary strength, adaptability, and determination.

As we reflect on the achievements encapsulated in this diagnostic report, we are reminded of the significance of education in shaping the future of our youth and, by extension, our country. The NSC is not just a certificate; it is a gateway to opportunities that empowers our young people to pursue further education, enter the workforce, and contribute to the socio-economic development of South Africa.

The 2024 NSC results are being released against a backdrop of significant developments in South Africa's education system. Three important benchmarking reports relating to the performance of the education system in the General Education and Training (GET) band were received in December 2024 and these included the Trends in International Mathematics and Science Study (TIMSS), the Southern and East Africa Consortium for Monitoring Educational Quality (SEACMEQ) assessment, and, for the first time, the South African Systematic Evaluation (SASE) study. We now have our own national evaluation study of Mathematics and Languages at the Grade 3, 6 and 9 levels and these results will be evaluated in the context of our international performance. Over the last two years the Department of Basic Education has also focussed on improving access to quality Early Childhood Development (ECD) programmes and this attests to the Department's commitment to addressing the educational challenges across the entire continuum of education delivery. The promotion of Mother-tongue Bilingual-based Education (MTBbE) promises to be a strategic driver in ensuring access to quality learning for all learners and thus building a more equitable educational landscape. These efforts, along with the

commitment to protect and optimise the education budget, underscore the Department's unwavering resolve to improve learning outcomes for all South African learners, laying the foundation for sustained progress in the years to come.

In his State of the Nation Address on 18 July 2024, President Cyril Ramaphosa reminded us of the profound words of the Father of our Nation, former President Nelson Mandela: "What brings us together is the overriding commitment to a joint national effort to reconcile our nation and improve its well-being." These words resonate deeply as we reflect on the achievements of the Class of 2024 in the National Senior Certificate (NSC) examinations. These results represent the collective efforts of educators, learners, parents, and communities across South Africa that will allow this cohort of young adults to take up their rightful places in society and thus build a brighter and more prosperous future for all. The progress made by the Class of 2024 stands as a testament to the power of unity and the continuous national effort to overcome challenges and elevate the quality of education in our country. Together, we are forging a path towards a more inclusive and equitable education system for generations to come.

As an education system we continuously evaluate our progress in terms of the social justice principles of access, redress, equity, quality, efficiency and inclusivity. In this examination 615 429 candidates obtained the National Senior Certificate and can now access further education opportunities and enter the world of work. In terms of quality, 337 158 learners have obtained admission to Bachelor studies and of that number 214 500, learners come from no-fee schools which reflects our disadvantaged communities. Reasonable strides have been made in addressing the educational needs of persons with disabilities and learners who experience barriers to learning. The South African Sign Language Home Language (SASL HL) examination is now in its 7th year of being offered in the National Senior Certificate (NSC) examinations. In addition, 3 321 learners with special needs have obtained admission to bachelor studies in this examination. These are tangible gains reflected in the National Senior Certificate examinations of 2024.

Over the next five years, the DBE will strengthen the Curriculum and Assessment Policy Statements (CAPS) to ensure the infusion of 21st-century skills into the education system. The revised curriculum will prioritise the development of essential skills and competencies required for success in the modern world, with a focus on deeper learning rather than simply covering extensive content. Key components of this strengthened curriculum will include an emphasis on

formative assessment approaches, alongside an increased focus on vocational and occupational education to equip learners with practical skills. The DBE remains committed to ensuring that critical thinking, creativity, and problem-solving are core to the educational agenda.

The NSC examinations stand as a reliable beacon of academic integrity, ensuring that learners' achievements are recognised and respected across various sectors, both locally and globally.

As we celebrate these remarkable results, we are reminded of the wisdom in the isiXhosa maxim, "Umntwana ukhula ngokufunda, ngokukhokelwa nokucetyiswa baphumelele,", which translates to, "A child grows through learning, and with guidance, they will thrive." This encapsulates the essence of our collective effort in shaping the future of our young people. Let us continue to build on these achievements and work together to ensure a bright and prosperous future for all learners in South Africa.

MS GWARUBE, MP
MINISTER OF BASIC EDUCATION
13 JANUARY 2025

1.1 INTRODUCTION, SCOPE AND PURPOSE

A diagnostic analysis of learner performance refers to a comprehensive assessment aimed at identifying the strengths and weaknesses in learner outcomes. This process involves not only assessing examination results but also understanding the underlying factors that contribute to performance trends. It highlights areas where learners excel and identifies the challenges that may hinder their academic progress. The goal is to provide a nuanced understanding of the challenges highlighted during the marking of the October/November 2024 examinations, which can then inform targeted support strategies to enhance learner achievement.

The 2024 Diagnostic Report on Learner Performance builds on the foundations laid by previous reports, including those from 2022 and 2023. This report offers an in-depth analysis of learner performance across key subjects with high enrolment, the 12 official home languages, the technologies, technical subjects, and Engineering Graphics and Design. The findings presented here are critical for teachers, subject advisors, curriculum planners, and other educational stakeholders, providing valuable insights into both the strengths and challenges within these subjects.

As with prior reports, the 2024 Diagnostic Report identifies areas of weakness within each subject or language and outlines the necessary remedial measures to be adopted at the school level to enhance learner performance. The data used to compile this report is derived from both qualitative and quantitative sources. Qualitative data comes from subject reports prepared by chief markers, internal moderators, and subject specialists, while quantitative data is collected from a random sample of 100 scripts per subject, per paper, across all provinces.

This National Diagnostic Report provides a comparative analysis of performance trends over the past five years for each subject, as well as detailed assessments of how learners performed in each question in the question papers. By identifying common errors, misinterpretations, and misconceptions, the report offers specific suggestions for improvement. The ongoing trend of poor-quality responses in certain subjects highlights persistent gaps in content coverage, teaching methodology, and the subject knowledge of some educators.

Part 1 of this report tracks the progress made in previously identified problematic areas. It assesses whether improvements have been made in these areas and highlights where further support may be necessary in 2024. This diagnostic analysis is not only intended for national-level use but also for implementation at provincial, district, and school levels, with the ultimate aim of institutionalising this practice within pedagogical methods across the education system.

1.2 METHODOLOGY

Each subject's diagnostic report begins with a presentation of comparative data on performance trends observed over a five-year period, from 2020 to 2024. The 2024 diagnostic report is based on qualitative analyses compiled by chief markers, internal moderators, and subject specialists following the marking of the NSC examinations. For the 10 key high-enrolment subjects, and English First Additional Language, quantitative data was gathered from the analysis of 100 scripts per question paper, per subject, randomly selected from each province. This combination of qualitative and quantitative data highlights areas of weakness in each subject and outlines the remedial measures that should be implemented at the school level to improve performance.

The report offers a detailed analysis per question and subquestion, structured under three main sections:

Section 1: Performance Trends (2020–2024)

This section presents a comparative analysis of learner performance over the past five years, focusing on the number of learners who sat for the examinations, the number and percentage of learners who achieved 30% and above, and the number and percentage of learners who attained 40% and above. These data are represented in tables and graphs, allowing for easier interpretation of trends, especially changes in performance over the medium term and between individual years.

Performance distribution curves are also included, which visually represent the distribution of learner scores across the last three years. Any improvement or decline in performance can be observed through the positioning of the 2024 graph in relation to the previous two years. If the 2024 graph shifts to the right, this suggests an improvement in performance, while a shift to the left would indicate a decline.

Section 2: Overview of Learner Performance

This section provides a broader overview of learner performance in the question paper, highlighting areas where learners performed well or struggled, and exploring possible reasons for these trends. It offers a holistic view of how learners engaged with the content and identifies any systemic issues that may have influenced their results.

Section 3: Diagnostic Question Analysis

This section includes the following:

- A graphical representation of the average percentage marks obtained per question;
- A detailed analysis of learner performance on each specific question, indicating whether the question was answered well or poorly, along with an explanation for the response patterns;
- Common errors and misconceptions identified in learner responses; and
- Recommendations for improvement in teaching and learning, content and methodology, subject advisory support, and the utilisation of Learning and Teaching Support Materials (LTSM).

The internal moderators' reports from all nine provinces for each question paper per subject have been consolidated, and the findings summarised in this report. It is recommended that this diagnostic report be read alongside the November 2024 NSC question papers, as it references specific questions within the respective question papers. This will allow educators to establish a baseline for the new cohort of Grade 12 learners in 2025, develop strategies for differentiated learning, and provide a framework for the design and implementation of school-based assessments throughout the year.

1.3 LIMITATIONS OF THE DIAGNOSTIC REPORT ON LEARNER PERFORMANCE

While the 2024 National Diagnostic Report on Learner Performance provides valuable insights into learner outcomes, it is important to acknowledge its limitations. These limitations should be considered when using the report as a tool for improving educational practice and guiding interventions.

1.3.1 Qualitative Focus

The primary focus of this report is qualitative rather than quantitative. The analysis primarily aims to provide a detailed examination of learner performance, identifying strengths and weaknesses in both content and instructional methods. The quantitative data included in the report is limited to performance trends within each subject and the average performance per question in the 2024 NSC question papers. While this quantitative information is useful for highlighting overall trends, it does not extend to a more granular level of analysis, such as individual test item development or the performance of specific learner cohorts. Further quantitative data could have provided additional insights, particularly for test development purposes, but this is not the intended scope of the current report.

1.3.2 Limited Subject Coverage

This report is restricted to the analysis of the 10 key subjects with high Grade 12 enrolment, including Afrikaans First Additional Language, English First Additional Language, the 12 official home languages, as well as the technologies and technical subjects. While these subjects are pivotal to understanding general trends in learner performance, it is important to note that this report does not encompass all subjects examined in the NSC. Other subjects will be addressed in separate reports compiled by provincial chief markers and internal moderators during the marking process. Therefore, the findings and recommendations presented here should be seen as focused on a specific subset of subjects, with additional reports available for other subject areas.

1.3.3 National-Level Overview

The diagnostic analysis provided in this report offers a national summary of areas of weakness observed in the key subjects. However, it is important to recognise that the areas of weakness identified may not be universally applicable across all districts and schools. Performance trends and challenges can vary significantly depending on regional and local factors, such as teaching methodologies, resource availability, and learner backgrounds. As such, the findings should be treated as a broad overview, rather than a precise reflection of weaknesses at a district or school level.

1.3.4 Need for District-Specific Reports

Given the variation in performance across districts, it is strongly recommended that district subject specialists take the initiative to develop district-specific diagnostic reports. These reports would allow for a more targeted analysis, addressing issues that are unique to specific regions and providing district-level insights that can inform local educational strategies and interventions. District reports would also facilitate more focused professional development for teachers based on the specific challenges and strengths within their region.

1.3.5 School-Level Specificity

While this report highlights general trends at the national level, it does not provide a detailed analysis of weaknesses at the individual school level. The unique context of each school, including teaching practices, learner demographics, and the availability of resources, means that the challenges and strengths at a local level may differ from the national summary. For more precise and actionable insights, it is essential for schools to develop their own diagnostic reports, which would focus specifically on the performance of their learners and the areas requiring

targeted improvement. Such school-level reports would serve as a crucial tool for developing tailored interventions that address the specific needs of learners.

1.3.6 Challenges in Data Representation

The nature of the data used in this report, particularly the random selection of scripts, means that some performance trends may not fully reflect the diversity of learners across different provinces or schools. While the sample size is significant, there may be limitations in how representative this data is of the broader learner population. Variations in marking standards and regional differences in examination conditions could also affect the consistency of the data, though efforts are made to mitigate these factors through standardised moderation processes.

1.3.7 Use of the Report

It is also important to note that while this report provides important insights, it is not a prescriptive tool for classroom practice. Rather, it offers a starting point for discussion and reflection on learner performance. Teachers, subject advisors, and curriculum implementers are encouraged to use the findings as part of a broader strategy for professional development, curriculum adaptation, and learner support, integrating them with other resources and localised data to best meet the needs of their learners.

1.4 OBSERVATIONS IN LEARNER PERFORMANCE

The 2024 diagnostic reports for the 10 key subjects covered in this publication (Part 1), indicate that the pass rate has improved in all of the key subjects at the 30% level, except in Physical Sciences. The pass rate for English First Additional Language increased at both the 30% and 40% levels. In all the home languages (Part 2) the pass rate improved. A general observation in the technologies and technical subjects is that performance shows a gradual improvement.

1.5 AREAS OF CONCERN

The marking of the NSC 2024 examinations revealed several recurring challenges that affected learner performance across various subjects. These challenges highlight areas where learners are struggling and require targeted interventions to improve their overall performance. Below are the major challenges observed, along with proposed solutions for addressing each one, including subject-specific examples.

1.5.1 Lack of Understanding of Instructional Verbs

Challenge: Many learners demonstrated a lack of understanding of the meaning of instructional verbs in questions, such as "explain," "analyse," or "compare."

Solution: It is essential to explicitly teach learners the meaning and requirements of common instructional verbs used in examinations. For example, in Economics, a question might ask learners to "analyse" the effects of inflation on a country's economy. Without understanding that "analyse" requires breaking down the topic into parts and evaluating each one, learners might provide a general description rather than a structured, detailed response. Teachers can create practice exercises that focus on these verbs, helping learners become familiar with their application in different contexts. Additionally, revision sessions could include exercises specifically targeting these skills to build better understanding.

1.5.2 Failure to Approach Follow-on Questions Effectively

Challenge: Some learners struggled with following through on questions that required sequential answers, indicating a lack of understanding of how to approach such questions.

Solution: Teachers can provide exercises that simulate question sequences, helping learners to understand how to break down a larger problem into smaller, manageable parts. For example, in Physical Sciences, a question may ask learners to first define the concept of energy, then apply it to a real-life scenario such as the conservation of mechanical energy. Learners should be taught how to approach these questions in steps. Additionally, learners can be taught strategies for linking ideas across different questions to maintain coherence in their responses.

1.5.3 Lack of Basic Numeracy Skills in Mathematical Subjects

Challenge: In subjects requiring mathematical proficiency, many learners lacked basic numeracy skills, which hindered their ability to solve mathematical problems accurately.

Solution: Support programmes focusing on basic numeracy skills should be implemented in earlier grades. In Physical Sciences, learners must be able to perform calculations such as converting units or calculating forces using Newton's laws. If learners struggle with basic arithmetic, they will find these calculations difficult, impacting their performance. Teachers could incorporate daily practice of foundational mathematical concepts and offer remedial classes for learners who struggle with basic skills. Regular quizzes and interactive exercises will also help reinforce numeracy skills.

1.5.4 Failure to Express Ideas Clearly and Concisely

Challenge: It was observed that some candidates were unable to express their ideas clearly and concisely, leading to poorly structured responses.

Solution: Teachers should focus on developing learners' writing skills, specifically encouraging clear and concise expression. For instance, in Life Sciences, learners may struggle to explain complex processes like meiosis or mitosis clearly. Teachers can guide them in structuring their answers, ensuring they focus on essential points. Writing workshops and peer review sessions where learners critique each other's work can help learners practise presenting their ideas logically and concisely.

1.5.5 Lack of Critical Analysis and Evaluation Skills

Challenge: Many candidates lacked the skill to analyse and evaluate information critically, which is vital for higher-order questions.

Solution: Critical thinking exercises should be integrated into all subjects, especially those that require analysis and evaluation. In Economics, a question might ask learners to evaluate the effectiveness of a government policy. Learners need to assess both the positive and negative impacts, considering various viewpoints and using relevant evidence. Teachers can include activities that encourage learners to assess different perspectives, evaluate sources of information, and justify their responses logically.

1.5.6 Poor Reading Comprehension Skills

Challenge: It was noted that many candidates lacked the skill to read with meaning, making it difficult for them to comprehend and respond to questions accurately.

Solution: Reading comprehension should be a focus in earlier grades, with regular exercises that challenge learners to analyse texts critically. For example, in English and other languages, learners may be asked to analyse a passage and identify literary devices such as metaphors or alliteration. Learners should practise reading such texts carefully, breaking down the content and interpreting it fully. In-class discussions and group activities that focus on understanding and interpreting reading material will help reinforce these skills.

1.5.7 Ineffective Use of Relevant Information in Responses

Challenge: Some candidates were unable to locate and use relevant information effectively in their responses, demonstrating a gap in research and information retrieval skills.

Solution: To address this, schools should focus on improving research skills by teaching learners how to gather, evaluate, and incorporate relevant information into their answers. In Physical Sciences, a question may ask learners to apply a principle like the law of conservation of energy to a practical situation. Learners need to locate and apply relevant formulae and scientific concepts in their answers. Practical exercises in sourcing and referencing information can improve their ability to use evidence effectively in their responses.

1.5.8 Disregard for Mark Allocation and Inadequate Responses

Challenge: In some instances, candidates disregarded the mark allocation of questions, resulting in overly brief or inadequate responses.

Solution: Teachers should stress the importance of mark allocation and the need to provide responses that align with the required level of detail. For instance, a question worth 4 marks requires a more detailed answer than a question worth 2 marks. Practice examinations should include an emphasis on matching the depth of the response to the marks allocated to each question. Teachers can also provide feedback on how to appropriately distribute time and effort across questions.

1.5.9 Over-Reliance on Past Papers

Challenge: It was noted that there was a heavy reliance on past papers, with many candidates expecting the examinations to follow predictable patterns. This hindered candidates' ability to apply subject content knowledge in unfamiliar contexts or scenarios.

Solution: It is crucial to encourage learners to go beyond past papers and develop a deeper understanding of the subject material. In Life Sciences, for example, learners may encounter a question on the human digestive system presented in a novel scenario, requiring them to apply their knowledge in a new context. Teachers should provide a variety of question types and scenarios to help learners become adaptable. Regular assessments with unfamiliar question formats will help learners be better prepared for diverse examination challenges.

1.6 KEY RECOMMENDATIONS TO IMPROVE THE QUALITY OF TEACHING AND LEARNING

The NSC 2024 examination performance has highlighted several areas for improvement in teaching and learning practices in various subjects. In response to these challenges, the following recommendations are proposed to enhance the quality of teaching and better equip learners for future assessments.

1.6.1 Integration of Artificial Intelligence (AI) in Teaching

The advent of Artificial Intelligence offers new opportunities to enhance teaching methods and provide personalised learning experiences. AI tools can help educators identify learning gaps and offer tailored interventions for individual learners. These technologies can also support the development of learners' critical thinking and problem-solving skills by providing instant feedback on tasks such as essay writing or mathematics exercises.

Recommendation: Teachers should explore the integration of AI-based learning platforms that offer adaptive learning paths for learners. For example, AI-driven educational apps in subjects such as Physical Sciences and Life Sciences could help learners visualise complex scientific phenomena, providing them with interactive simulations. Such tools would be beneficial in reinforcing theoretical concepts, particularly in subjects that require visualisation, such as chemistry.

1.6.2 Adoption of New Approaches to Learning

Traditional teaching methods must evolve to accommodate the changing needs of learners in an increasingly digital world. Collaborative learning, project-based assessments, and flipped classrooms are examples of innovative approaches that promote deeper engagement with the material. These methods encourage learners to take responsibility for their learning, work collaboratively, and apply theoretical knowledge to practical situations.

A flipped classroom is an innovative teaching approach where traditional learning structures are reversed. In this model, instead of spending class time introducing new content through 'chalk and talk', learners first engage with the material independently, often through pre-recorded videos, readings, or other online resources. This allows classroom time to be dedicated to more interactive, hands-on learning activities, such as discussions, problem-solving, group work, or applying the concepts learned.

Recommendation: Teachers should incorporate more active learning strategies into their lessons. For example, in Economics, learners could work in groups to analyse case studies of real-world economic issues, followed by presentations and debates on their findings. Such approaches promote critical thinking, teamwork, and effective communication, while also encouraging learners to approach problems from different angles.

1.6.3 Addressing Different Cognitive Levels and Learning Styles

Learners come from diverse backgrounds and possess varying cognitive abilities. The teaching and learning process must accommodate these differences to ensure that all learners can succeed. By addressing the range of cognitive levels and learning styles, teachers can help learners build on their strengths and address areas of weakness effectively.

Recommendation: Teachers should differentiate instruction to cater to the different cognitive levels of their learners. For instance, additional support materials can be provided to learners who are struggling with basic concepts. Incorporating varied learning activities, such as hands-on experiments, group discussions, and interactive multimedia, ensures that learners with different learning styles (visual, auditory, kinaesthetic) are effectively engaged.

1.6.4 Incorporating Higher-Order Thinking Skills in Assessments

It is essential to design assessments that encourage learners to think critically and analytically. This includes moving beyond rote memorisation to include tasks that require learners to evaluate, analyse, and synthesise information. By promoting higher-order thinking, teachers can prepare learners for complex problem-solving scenarios in both examinations and real-world contexts.

Recommendation: Assessment design should include a range of question types that test different cognitive levels. For example, language examinations should include tasks that ask learners to not only summarise a text or merely lift information but also critically analyse its themes, structure, and literary techniques. This will allow learners to demonstrate a deeper understanding of the material and strengthen their critical thinking skills. Teachers should ensure that questions at all levels of difficulty (from recall to synthesis) are well-represented, enabling learners to demonstrate their knowledge comprehensively.

1.6.5 Progressive Levels of Difficulty in Question Papers

It is crucial to design question papers and tasks for school-based assessment that progressively increase in difficulty, enabling learners to build confidence as they progress through the paper or task. A well-structured question paper should begin with easier questions that test foundational knowledge and gradually move to more challenging questions that assess the ability to apply, analyse, and evaluate information.

Recommendation: Teachers should collaborate to design question papers that follow a logical progression of difficulty. For example, in Physical Sciences, a question paper could begin with basic recall questions on the periodic table, followed by questions that require application (e.g. calculating chemical reactions), and culminate in higher-order questions that ask learners to critically evaluate the environmental impact of chemical processes. This approach ensures that learners are not overwhelmed and have the opportunity to demonstrate their full range of abilities.

1.6.6 Focus on Digital Literacy and Information Retrieval Skills

In today's digital age, learners must be equipped with the skills to effectively search for, evaluate, and use information from a variety of sources. This is particularly important for subjects such as Economics, where learners may need to research current events or analyse economic data from diverse sources.

Recommendation: A digital literacy should be a core focus in the classroom, with learners being taught how to use online databases, search engines, and academic resources for research. For instance, in Life Sciences, learners can be taught how to access and interpret scientific articles and databases to support their answers in examinations and projects. Teachers should incorporate information literacy tasks into their lessons, ensuring learners are proficient in finding and using relevant, credible sources.

1.6.7 Encouraging Learner Independence and Self-Directed Learning

Developing learner independence is essential for fostering a culture of lifelong learning. Self-directed learning encourages learners to take charge of their education, set goals, and seek out resources to achieve them. This is particularly important for learners preparing for examinations such as the NSC, where self-motivation and effective study habits can make a significant difference.

Recommendation: Teachers should promote self-directed learning by incorporating independent research projects, self-assessment activities, and opportunities for reflective learning into their teaching. In English and other languages, learners could be tasked with reading a range of texts independently and then completing a critical review or comparative essay, allowing them to demonstrate their ability to research and articulate their thoughts independently. Teachers should guide learners in developing effective study habits and time management skills, helping them to balance independent learning with classroom instruction.

1.7 RESPONSIBILITIES: MEDIATING THE 2024 DIAGNOSTIC REPORT

The successful implementation of the recommendations outlined in this diagnostic report depends on effective communication and mediation at various levels of the education system. It is crucial that the report is disseminated and utilised from the provincial level down to individual schools, with a focus on active involvement from subject specialists, district officials, and teachers.

1.7.1 Provincial Education Departments

This diagnostic report is intended for a broad audience, including teachers, learners, and education officials. As such, it is imperative that the report is cascaded systematically from the provincial level to the district and school levels. This process will ensure that the findings and recommendations reach the relevant stakeholders, allowing for the identification of areas of improvement and the implementation of targeted interventions. Provincial education departments should take responsibility for ensuring that the diagnostic report is shared with all schools within their jurisdiction, enabling the entire education system to benefit from the insights provided.

1.7.2 Subject Advisors and District Officials

Subject Advisors' Meetings and Workshops

Subject advisors play a key role in facilitating professional development and ensuring that the diagnostic report is effectively mediated. They should organise meetings or workshops where teachers can discuss the findings of the report and explore strategies for addressing the challenges identified. These sessions should focus on fostering collaboration among teachers, encouraging the sharing of best practices, and providing guidance on how to incorporate the recommendations into classroom teaching.

Monitoring Teacher Improvement Plans

It is essential that subject advisors monitor the improvement plans of teachers, ensuring that the recommendations in the diagnostic report are incorporated. This will help teachers to make the necessary adjustments in their teaching approaches, thereby improving learners' performance. Monitoring should focus on specific actions and strategies that align with the identified areas for improvement.

Curriculum Coverage Monitoring

District officials must ensure that the curriculum is being adequately covered in accordance with the Revised Annual Teaching Plan (ATP). This is particularly important to ensure that learners are fully prepared for the demands of the examinations. Incomplete or rushed curriculum coverage can leave critical gaps in learners' knowledge, hindering their ability to respond effectively to exam questions. Ensuring that all topics are adequately covered will provide learners with the necessary preparation to succeed in the NSC exams.

Monitoring SBA Quality and Standard

The monitoring process should also focus on the quality of the School-based Assessments (SBA). High-quality assessment tasks, aligned with the learning objectives and cognitive levels of the curriculum, are essential in preparing learners for the NSC examinations. District officials should ensure that SBA tasks are of a high standard, providing learners with the opportunity to develop and demonstrate their understanding of the content.

Enhancing Teaching Resources

Subject advisors should direct teachers to relevant online resources, educational websites, and digital tools that can enhance teaching and learning. These resources can provide teachers with access to updated content, innovative teaching strategies, and interactive activities to engage learners, ensuring that learners receive the most up-to-date and effective instruction.

1.7.3 Teachers

Providing Resources for Self-Regulated Learning

Teachers and schools must ensure that learners have access to adequate resources that enable self-regulated learning. This will empower learners to take ownership of their education, improving their ability to study independently. Teachers should guide learners in using textbooks, online resources, and supplementary materials to reinforce their understanding.

Creating Opportunities for Reflection, Analysis, and Evaluation

Teachers should prepare learners for the demands of the NSC examinations by creating opportunities for them to reflect on, analyse, and evaluate the content. This will foster deeper understanding and applied competence, helping learners develop critical thinking skills that are necessary for tackling complex exam questions.

Ensuring Comprehensive Curriculum Coverage

Teachers must ensure that they cover the entire curriculum and include a full range of cognitive levels in both teaching and assessment strategies. Simple recall-based tasks will not adequately prepare learners for the higher-order thinking required in the NSC exams. Teachers should focus on creating learning opportunities that encourage analysis, evaluation, and application of knowledge to ensure that learners are fully equipped to tackle a range of question types in the examinations.

CHAPTER 2

TECHNICAL MATHEMATICS

The following report should be read in conjunction with the Technical Mathematics Paper 1 and Paper 2 question papers for the NSC November 2024 examinations.

2.1 PERFORMANCE TRENDS (2020–2024)

The number of candidates who sat for the Technical Mathematics examination in 2024 increased by 1 386, compared to that of 2023.

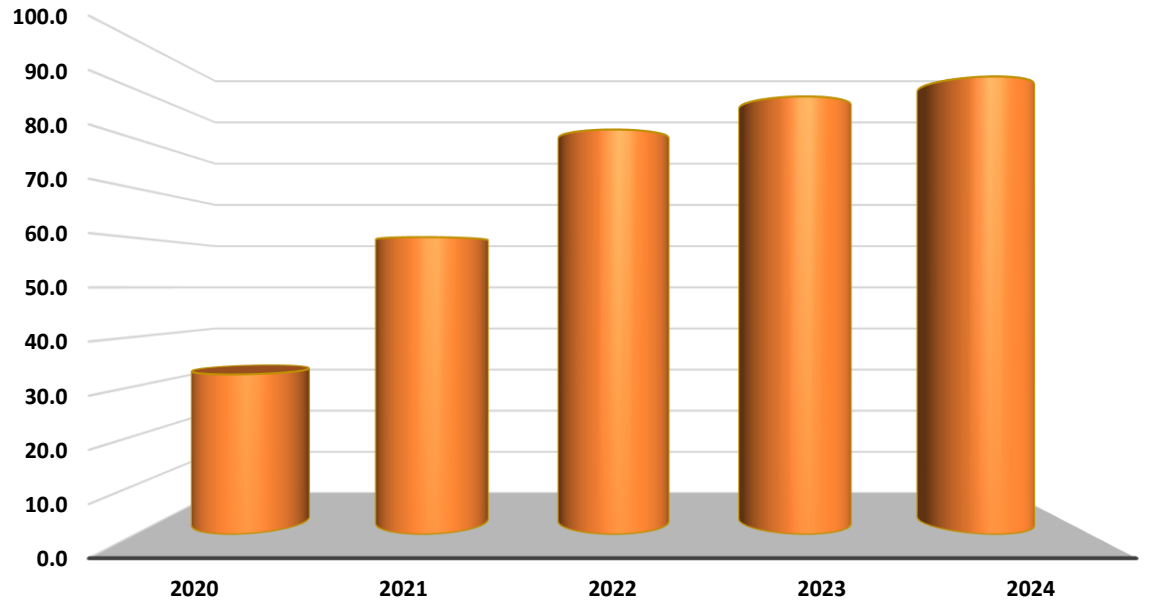
There was a significant improvement in the pass rate this year. Candidates who passed at the 30% level improved from 88,5% in 2023 to 92,5% in 2024. The percentage of distinctions over 80% improved from 2,4% in 2023 to 4,2% in 2024. Given the increase in the size of the 2024 cohort, this converts into an increase in the total number of distinctions from 365 to 696.

The various commendable intervention strategies employed by teachers, subject advisors and provincial education departments were continued in 2024. The resourcefulness and diligence of the above-average candidates also contributed to the overall improvement in the subject.

Table 2.1.1 Overall achievement rates in Technical Mathematics

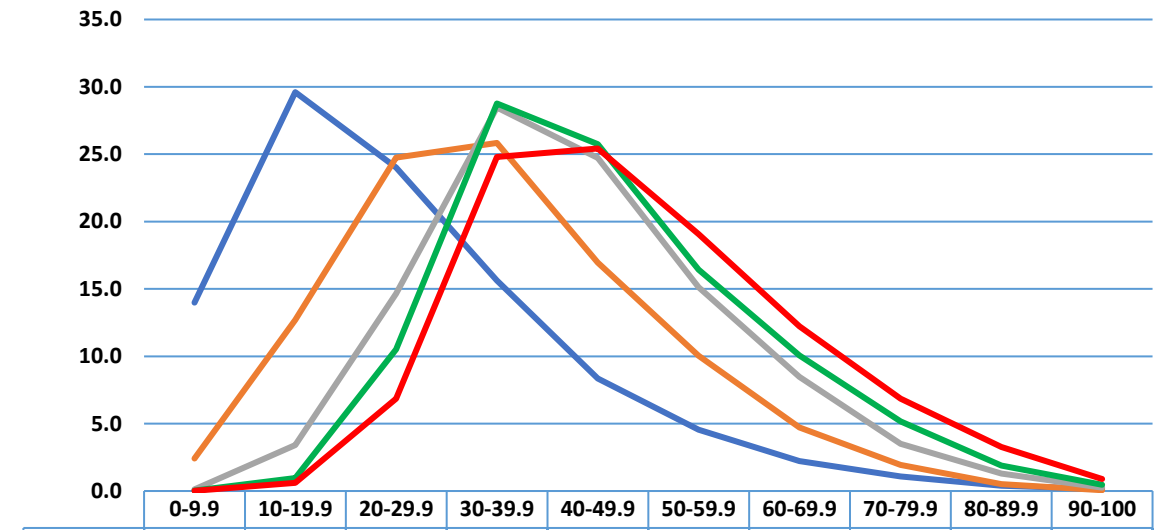
Year	No. wrote	No. achieved at 30% and above	% achieved at 30% and above
2020	10 731	3 476	32,4
2021	13 403	8 060	60,1
2022	14 657	11 993	81,8
2023	15 193	13 446	88,5
2024	16 579	15 340	92,5

Graph 2.1.1 Overall achievement rates in Technical Mathematics (percentage)



	2020	2021	2022	2023	2024
% achieved at 30% and above	32.4	60.1	81.8	88.5	92.5

Graph 2.1.2 Performance distribution curves in Technical Mathematics (percentage)



	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	90-100
2020	14.0	29.6	24.0	15.6	8.4	4.6	2.2	1.1	0.4	0.1
2021	2.4	12.7	24.7	25.8	17.0	10.0	4.7	1.9	0.5	0.1
2022	0.1	3.4	14.6	28.5	24.7	15.1	8.5	3.5	1.3	0.2
2023	0.0	1.0	10.5	28.8	25.7	16.4	10.1	5.2	1.9	0.5
2024	0.0	0.6	6.9	24.8	25.4	19.1	12.2	6.9	3.3	0.9

2.2 OVERVIEW OF CANDIDATE PERFORMANCE: PAPERS 1 AND 2

General comments

The 2024 NSC examinations revealed an improvement of candidates' understanding of some basic concepts across topics in the curriculum. While the use of past examination papers as a valuable resource for revision is advised, the teaching and learning of basic mathematical concepts cannot be over-emphasised.

The *CAPS* states that 'Mathematical modelling is an important focal point of the curriculum' and 'Real-life technical problems should be incorporated into all sections whenever appropriate'. Teachers are reminded not to overlook this aspect when teaching. Performance will be further enhanced if attention is given to the following areas: strengthening the content knowledge in nature of roots, interpretation in functions and graphs, Calculus applications, Euclidean Geometry and Trigonometry. The exposure of learners to complex and problem-solving questions across all topics in the curriculum, starting in the earlier grades cannot be overlooked.

2.3 OVERVIEW OF CANDIDATES' PERFORMANCE IN PAPER 1

General comments

(a) The majority of candidates were able to respond and score marks in questions requiring knowledge and routine in many of the questions in the paper. This is an indication that candidates were better prepared to deal with these questions.

(b) Some candidates displayed poor algebraic skills required to solve many mathematical problems. This was evident in topics where interpretation and integration of topics was required.

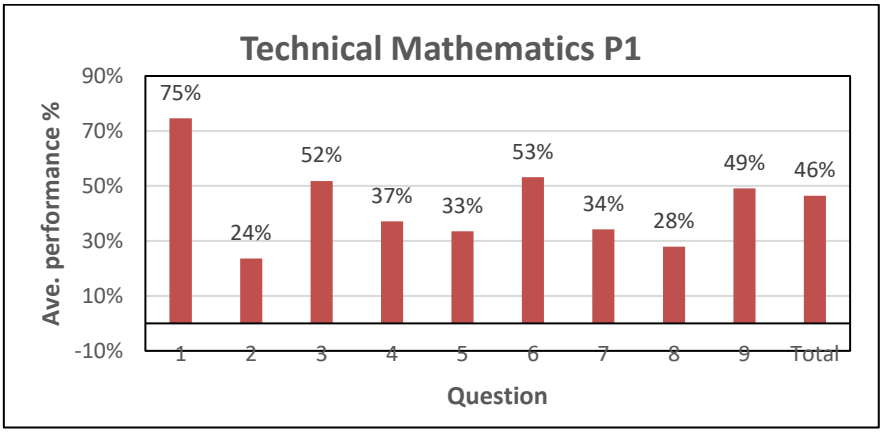
(c) While candidates performed well in questions assessing topics done in the lower grades, it is equally important that they are able to tackle questions requiring deeper understanding of definitions and concepts incorporating real-life technical applications.

(d) Some candidates did not adhere to the instructions as stipulated in the question paper such as the correct numbering of questions, and the use of the answer sheet for diagrams to be submitted with their answer book. The use of a calculator was still a challenge for some of the candidates.

2.3 DIAGNOSTIC QUESTION ANALYSIS OF PAPER 1

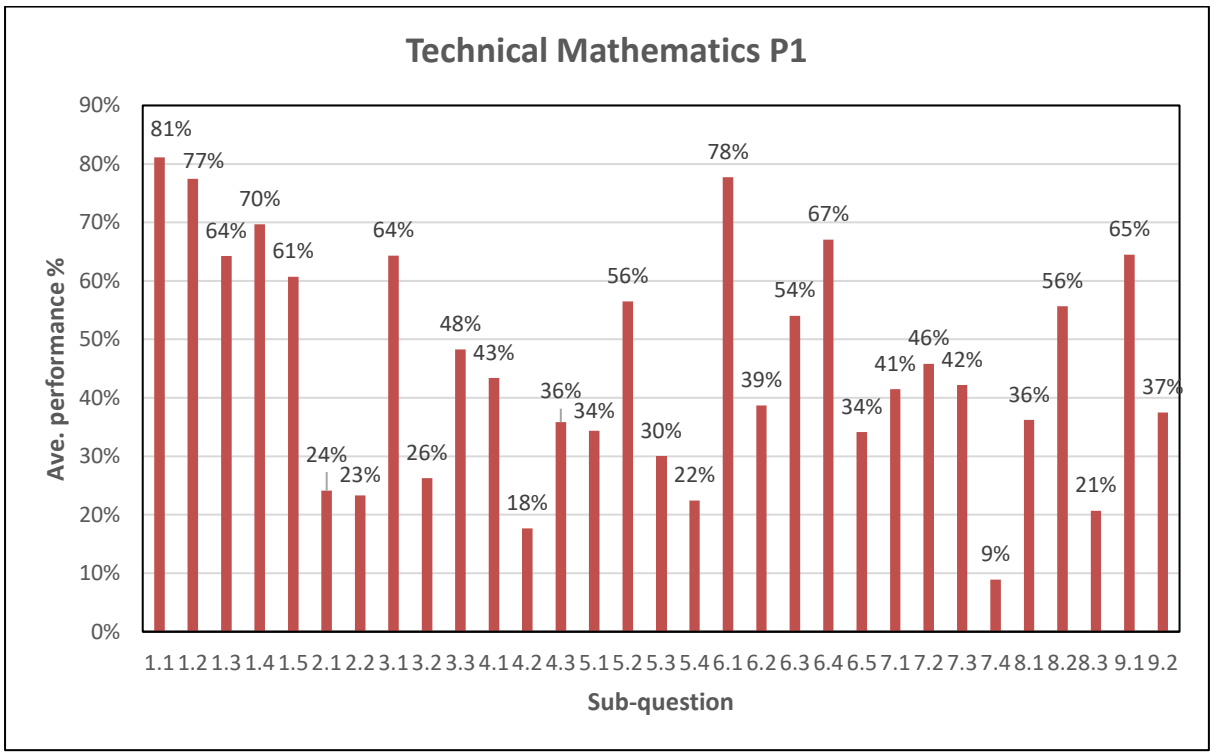
The following graph is based on data from a random sample of candidates. While this graph might not accurately reflect national averages, it is useful in assessing the relative degrees of challenge of each question as experienced by candidates.

Graph 2.3.1 Average performance per question in Paper 1



Question	Topic
1	Equations, Inequalities and Binary numbers
2	Nature of roots of quadratic equations
3	Exponents, Surds, Logs and Complex numbers
4	Functions and Graphs
5	Finance, Growth and Decay
6	Differential Calculus (Differentiation)
7	Differential Calculus (Cubic Graph)
8	Differential Calculus (Optimisation)
9	Integration

Graph 2.3.2 Average performance per subquestion in Paper 1



2.4 ANALYSIS OF CANDIDATES' PERFORMANCE IN EACH QUESTION IN PAPER 1

QUESTION 1: EQUATIONS AND INEQUALITIES (ALGEBRA)

Common errors and misconceptions

(a) In Q1.1.1 some candidates decided to find the product of the given factors form to get the correct standard form and failed to factorise again or substitute correctly into the quadratic formula. A few candidates failed to solve x (2x+7) = 0; instead, they wrote x = - 2 or x = - 7 while others wrote x = - 7/2 only, omitting x = 0.

(b) Some candidates struggled to write the equation in standard quadratic form in Q1.1.2. They wrote $3x^2 - 6 - 5x = 0$. A few candidates copied the formula incorrectly. Some candidates failed to substitute correctly in the formula.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$
$$= \frac{-(3) \pm \sqrt{(3)^2 - 4(-4)(-6)}}{2(-4)}$$
$$= Maths\ error\ or\ No\ solution$$

They displayed a lack of competence in using the calculator and rounding off to the required number of decimal places.

(c) In Q1.1.3 many candidates failed to interpret the inequalities; they struggled to write the correct notation even if they got the critical values correct, $-5 \geq x \geq 2$ or $-5 < x < 2$ They displayed limited understanding of the set builder notation and the meaning of 'or' and 'and'. Some candidates used graphical representation of the solution but failed to identify the correct region.

(d) In Q1.2 some candidates failed to make y the subject of the formula in both equations. They tried to create a third equation by making x the subject in the linear equation which had a fraction in it and failed to simplify later to get their answer. Some candidates decided to make x the subject of the formula so that they remained with y as the only unknown variable, $2y^2 - 4y - 16 = 0$ or $y^2 - 2y - 8 = 0$ but they made an error in the quadratic formula and used $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ instead of $y = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ and used values of x and y interchangeably.

(e) Many candidates failed to simplify the fraction to make *CV* the subject of the formula in Q1.3.1.

(f) A number of candidates failed to substitute the given values in Q1.3.2 correctly. In the substitution of the compression ratio $9,5:1$, most candidates ignored 1 altogether and substituted $9,5$ only.

(g) In Q1.4.1 some candidates were unable to convert a binary number to a decimal number and a few candidates used base 10 instead of base 2.

(h) In Q1.4.2 many candidates failed to change either binary to decimal or decimal to binary. They tried to multiply the binary and decimal numbers simultaneously.

Suggestions for improvement

(a) It is strongly advised that teachers undertake an intensive revision of topics done in earlier grades, e.g. factors, products, solution of simultaneous equations, fractions and binary number operations,.

(b) Learners should be exposed to different forms of literal equations, subject of the formula, simplification and the correct use of calculators.

(c) Teachers should expose learners to different methods of solving inequality problems so that learners are able to choose the method best suited to solving the problem and to representing solutions i.e. verbally, graphically, interval notations, set builder notations and number lines.

(d) There must be an integration of Algebra with Functions when teaching, for learners to have visual understanding of the area in the graph that is applicable to the inequality under consideration. The difference between 'or' and 'and' in the context of inequalities must be explained.

QUESTION 2: NATURE OF ROOTS

Common errors and misconceptions

(a) In Q2.1.1 many candidates displayed limited understanding of undefined fractions. They did not realise that the roots for the values of x to be undefined, the denominator must be equal to zero. They wrote $3-p<0$ instead of writing $3-p=0$; as a result, they gave the answer as $p<3$ instead of $p=3$.

Some candidates used the discriminant in an attempt to answer this question and wrote $1-7p<0$, meaning that they did not know the difference between the roots being undefined and the roots being non-real.

(b) Some candidates used an incorrect condition of the discriminant for the non-real roots in Q2.1.2. They used $1-7p>0$ and others used $1-7p=0$. A few candidates failed to change the inequality sign after dividing by -7 on both sides of the inequality. They ended up having $p<\frac{1}{7}$

(c) In Q2.2 some candidates failed to get the correct standard form. They were unable to identify the correct values of a, b and c hence they substituted incorrectly. They wrote $x^2 - 3x - 3t = 0$ and $\Delta = (-3)^2 - 4(1)(-3) = t$. Some candidates wrote $\Delta = x^2 - 3x - 3t = 0$. Many candidates failed to interpret the meaning of equal roots in relation to $\Delta = b^2 - 4ac$.

Suggestions for improvement

(a) In teaching the nature of roots, teachers should emphasise that the discriminant, $\Delta = b^2 - 4ac$, is used to determine the nature of roots of the quadratic equation. They should demonstrate and explain to learners that the discriminant, $\Delta = b^2 - 4ac$ originates from the quadratic formula $x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$. In other words, the quadratic formula could be written as $x = \frac{-b \pm \sqrt{\Delta}}{2a}$.

(b) Teachers should integrate teaching the nature of roots with the graph of the parabola as visual representation to ensure greater insight and understanding of real, equal, rational, irrational, unequal and non-real roots.

(c) Teachers should emphasise to the learners that the inequality sign changes after division/multiplication by a negative number on both sides as taught in earlier grades.

(d) Learners should be exposed to problems involving the nature of roots where conditions are given.

QUESTION 3: EXPONENTS, SURDS, LOGARITHMS AND COMPLEX NUMBERS

Common errors and misconceptions

(a) In Q3.1.1 some candidates failed to correctly apply laws of exponents and to follow the instruction to leave the answer in simplified form.

(b) Expansion of $\left(1+\sqrt{3}\right)^2 - \sqrt{12}$ posed a challenge for most candidates in Q3.1.2. They tried to square the binomial $\left(1+\sqrt{3}\right)^2$ and arrived at $1+\sqrt{3}+3$ as an answer instead of $1+2\sqrt{3}+3$, which eventually resulted in an incorrect simplification. Some candidates used a calculator to get to the final answer without showing all the workings**,**

$$\left(1+\sqrt{3}\right)^2 - \sqrt{12}$$
$$= \left(1+\sqrt{3}\right)\left(1+\sqrt{3}\right) - \sqrt{12}$$
$$= 4$$

(c) A few candidates failed to apply the log property in Q3.1.3; they wrote $\log_p p = 0$ instead of = 1.

(d) Many candidates had challenges in representing sin30^o as $\frac{1}{2}$ or 2^{-1}. They failed to apply logarithmic properties in Q3.1.4.

(e) In Q3.2 some candidates failed to simplify the exponents using the exponential laws. They wrote $5^{(x+2)} - 5^x = \frac{24}{5}$ as $5^x.5^2 - 5^x = 5^{24}$

$$x + 2 + x = 24$$
$$x = 11$$

(f) Some candidates were able to make a substitution but failed to simplify to the required form in Q3.3.1.

(g) In Q3.3.2 some candidates changed the sign on the real part of the complex number instead of the imaginary part.

(h) Some candidates failed to draw an argand diagram in the correct quadrant in Q3.3.3. A few did not label the graph correctly; they interchanged the real and imaginary parts when plotting the graph. Some drew a parabolic graph.

(i) In Q3.3.4 many candidates could not identify the correct quadrant. Some confused the reference angle with the actual angle. Some even went beyond the scope of curriculum by presenting the angle as a negative angle.

Suggestions for improvement

(a) Teachers should intensify the revision of all exponential, surd and logarithmic properties, which are taught to learners in earlier grades.

(b) Plotting and labelling of diagrams should be demonstrated to learners using various graphing software. Teachers should teach learners to determine the reference angle separately and write the reference angle as positive. Emphasis should be on the quadrants where the complex number Z lies.

(c) Expose learners to different types of questions involving complex numbers. Learners must be encouraged to adhere to the given instructions.

(d) Familiarise learners with the special answer sheet during the writing of tests and internal examinations.

QUESTION 4: FUNCTIONS

Common errors and misconceptions

(a) In Q4.1.1 some candidates failed to write the correct equation of the asymptote. They wrote -1 instead of $y=-1$, and ignored the fact that an equation contains an equal sign. They also wrote the asymptote as $q=-1$ or as a function of x, i.e. $f(x)=-1$ or $f=-1$.

(b) In Q4.1.2 many candidates were unable to write the correct notation; they presented the solution as:
$-5\le 0\le 5$ or $-5\le x\ge 5$ or $x\in(-5;5)$
$-5\le x$ or $5\ge x$

Some candidates did not simplify into the square root; they wrote domain in surd form i.e. $x\in[-\sqrt{25};\sqrt{25}]$. A number of candidates displayed limited understanding of the meaning of the curved bracket and the square bracket, and the difference thereof. They wrote $x\in(-5;5)$ instead of $x\in[-5;5]$.

(c) In Q4.1.3 a few candidates failed to substitute $y=0$ and apply laws of exponents to solve for x; rather they wrote 3^x as $3x$ or divided by 3, i.e. $3^x=1$ and therefore $x=\frac{1}{3}$.

(d) In Q4.1.5 some candidates could not sketch the graphs. They were confused about the shapes of the required graphs. Instead of sketching the graph h as a semi-circle, some candidates decided to sketch the circle. Some drew a hyperbola instead of an exponential graph. A few candidates indicated the intercepts with the axes on the Cartesian plane without sketching any graph.

(e) Aa number of candidates were challenged by the given statement which required them to interpret in relation to the given functions in Q4.1.6. Most candidates displayed a lack of knowledge in interpretation of graphs and they committed notation errors. A few candidates left out $x = 5$ as part of the solution.

(f) In Q4.2 some candidates incorrectly substituted the points $\mathrm{K}(3;\,4)$ and $\mathrm{R}(1;-4)$ into $g(x) = a(x-p)^2 + q$. A few of them expanded the given equation before substituting the values of *p* and *q* and could not go further. Some candidates tried to use the equation $f(x) = a(x-x_1)(x-x_2)$ and substituted the x-coordinate of R, $x = 1$ into x_1 the x-coordinate of K, $x = 3$ into x_2.

(g) Many candidates failed to write two equations of asymptotes in Q4.3.1. They wrote coordinates (0; 2) or just 0 and 2, while others wrote $p = 0$ and $q = 2$ instead of $x = 0$ and $y = 2$.

(h) In Q4.3.2 a few candidates tried to substitute the point $\mathrm{A}(k;4)$ on $h(x) = \frac{a}{x} + q$ whereas the point did not lie on the graph of h and there was not enough information given about the equation of h. A few of them used the graph of h to solve the value of k instead of $p(x) = x + 2$ and they did not conceptualise the answer as some got k as – 2 but the quadrant has positive x-values. Some calculated the x-intercept yet k is not an intercept but a point on the straight line and is positive: $0 = k + 2 \;\therefore k = -2$ or they substitute 4 in place of x and still solved the value of k i.e. $y = 4 + 2 = 6$.

(i) Many candidates did not realise that the x-coordinate of B lay on the x-axis wherein the y-value of the hyperbola was the same as the y-value of straight line at point $A(k;4)$ in Q4.3.3.

(j) In Q4.3.4 some candidates were unable to determine the value of *a* thus the equation of the hyperbola.

Suggestions for improvement

(a) Teachers should emphasise to learners that when a question requires the equation of the asymptote, it should be presented as $y =$…. or $x =$…, depending on the asymptotes that are required.

(b) The meaning of inequalities, definition, correct notation and difference between the domain and range of a function should be thoroughly explained and demonstrated to learners.

(c) Properties of graphs should be thoroughly demonstrated to learners using various graphing software and transformation should be incorporated in the teaching of functions and graphs to illustrate the effects of the parameters.

(d) Learners should be exposed to different ways of determining the equations of the graphs, including the use of table-method to draw functions, should they find it difficult using the characteristics of graphs.

(e) In teaching functions and graphs, teachers should not only focus on the drawing of graphs; interpretation should also be incorporated.

(f) Learners should be exposed to different applications involving two graphs on the same system of axes and interpretation thereof.

(g) Teachers should focus on drilling and developing the conceptual understanding of the interpretation of graphs, especially when given cases such as $f(x) \times h(x) \leq 0$, $f(x) - g(x) \leq 0$ etc. Solving problems of this nature using algebraic methods should be discouraged.

QUESTION 5: FINANCE, GROWTH AND DECAY

Common errors and misconceptions

(a) In Q5.1 many candidates failed to identify and use the correct formula to determine the nominal interest rate. Some candidates incorrectly substituted the effective and nominal interest rate and were unable to make *i* the subject.

(b) A few candidates used the simple interest formula $\mathrm{A} = \mathrm{P}(1 + in)$ to calculate the population instead of using the compound interest formula $\mathrm{A} = \mathrm{P}(1+i)^n$ in Q5.2.

(c) In Q5.3.1 a few candidates were unable to calculate percentage. They wrote 260000×25 instead of $260000 \times 0,25$ or $260000 \times 25\%$.

(d) Many candidates had difficulty interpreting Q5.3.2. Some did not realise that they had to use the reducing-balance depreciation formula to determine the period, instead they interchanged the values of *A* and *P*; others failed to convert the exponential form to log form. Many candidates rounded off their final answer to n =1 because of early rounding.

(e) In Q5.4 some candidates failed to identify and use the correct formula. Many candidates displayed a limited knowledge of the different compounding periods. They did not realise that R20 000 was the initial investment amount and R3 000 had to be subtracted from the value of the investment after 18 months.

(f) Some candidates failed to use the calculator correctly and rounded early in the calculation.

Suggestions for improvement

(a) Learners should be encouraged to identify the correct formula from the information sheet attached to the question paper. Teachers should demonstrate and explain how to change the subject of the formula using the different variables in the formulae.

(b) Teachers should explain to learners that, in all formulae, *P* represents the initial value. In the case of a population, *P* represents the initial number, and *A* represents the final number of species in the situation. Furthermore, it must be emphasised that in scenarios that involve depreciation, the value of *P* will be greater than the value of *A*.

(c) The use of timelines to better understand a complex problem involving several investments, deposits and withdrawals, is strongly advised. Teachers should thoroughly teach learners the different compounding periods (annually, quarterly, monthly, semi-annually/half-yearly and even daily).

(d) Learners should demonstrate competency in using a calculator and not round off too early in the calculation.

(e) Revision of finance concepts done in earlier grades, e.g. percentages, interest, hire purchase, inflation and other real-life applications, is strongly suggested.

QUESTION 6: CALCULUS

Common errors and misconceptions

(a) In determining the derivative using first principles in Q6.1, some candidates:

- Incorrectly copied the definition and committed notational error,

  $f(x) = \frac{f(x+h) - f(x)}{h}$ or $f(x) = \lim_{x \to 0} \frac{f(x+h) - f(x)}{h}$

  or $f'(x) = \lim_{x \to 0} = \frac{f(x+h) - f(x)}{h}$

- Failed to substitute and use brackets correctly leading to incorrect simplification,

  $f(x+h) = f(9x-6)$ or $f(x+h) = 9x - 6(x+h)$

  or $f'(x) = \lim_{x \to 0} \frac{9x + 9h - 6 - 9x - 6}{h}$

  or $f(x+h) = 9x + h - 6$

(b) Many candidates did not realise that the $11\pi^2$ is a constant in Q6.2.1; instead, they differentiated with respect to π instead of .

(c) In Q6.3.1 some candidates had difficulty in simplifying the fraction; as a result, they were unable to find the derivative thereafter.

(d) Candidates in Q6.4.2 had difficulty changing the surd form to exponential form and detecting the final stage of the derivative, i.e. when to drop the Dx. A few candidates decided to do integration instead of differentiation.

(e) In Q6.5.1 many candidates did not realise that they needed to use the derivative function.

(f) Many candidates displayed a poor understanding of what a gradient of the tangent to the curve:

- In Q6.5.2 they incorrectly substituted in $g(-2) = -(-2)^3 + 6(-2)^2 = 32$ instead of $g'(-2) = -3(-2)^2 + 12(-2) = -36$.

- In Q6.5.3 some candidates incorrectly equated $g(x)$ to -36, i.e. they wrote $-x^3+6x^2=-36$ instead of $-3x^2+12x=-36$.

Suggestions for improvement

(a) Teachers need to demonstrate to learners the meaning of function values and to give examples that are not limited to numbers.

(b) Teachers should emphasise that when using first principles, the definition for first principles should be copied correctly from the information sheet attached to the question paper and the correct notation should be used.

(c) Revision of simplification of expressions involving algebraic fractions, exponential and surd laws before teaching differentiation is advised.

(d) Learners should be taught to differentiate between the different forms of differentiation, terms and their connection used in Calculus.

$\frac{dy}{dx}$ means differentiate y with respect to x and $\frac{dy}{dr}$ means differentiate y with respect to r.

(e) Teachers should expose learners to various notations used in differentiation. The notations $f'(x)$ if $f(x)=x^n$, $\frac{dy}{dx}$ if $y=x^n$, $\frac{d}{dx}(x^n)$ and $D_x(x^n)$ all have the same meaning. The difference between the derivative and an integral of a function should be thoroughly demonstrated and explained to learners by finding the derivative and integral of the same function.

(f) Application of Calculus should be taught to learners and should related to real-life scenarios. The derivative function in relation to gradient at a point on a curve or gradient of a tangent should be clearly defined and demonstrated using relevant mathematical software.

QUESTION 7: CUBIC FUNCTION

Common errors and misconceptions

(a) In Q7.1 some candidates did not realise that the length should be positive; instead they wrote the length of OD = □ 60. A few candidates presented the length in coordinate form, like $D(0;-60)$ or $D(0;60)$.

(b) Some candidates displayed limited understanding of the Factor Theorem in Q7.2. They struggled to determine the quadratic factor of the cubic equation. Some candidates confused the x-intercepts with turning points; they used differentiation to find the points. A few candidates used midpoint formulae to find the x-intercepts. Some candidates failed to correctly place the coordinates with the symbol they belong to; they gave their answers as $A(6;0)$ and $C(-5;0)$.

(c) In Q7.3 many candidates were unable to find the coordinates of G. They used quadratic factor to find the coordinates of G and some ended up with equation of a straight line. Few candidates simplified up to the step where they got a surd and did

not simplify further. Some candidates did not realise that the *y*-coordinate of G corresponds with $x = 2,95$, which is the x-coordinate of point F.

(d) Most candidates were greatly challenged by Q7.4.1 as it required interpretation of graphs. They displayed poor understanding of notation used when a function is increasing or decreasing. Many of them could not identify the region from where the answer is obtainable in the graph. Some candidates included $x \geq 6$ as part of their answer, meaning that they did not take into consideration the condition $x < 0$.

(e) In Q7.4.2 many candidates were unable to interpret the inequality signs like *greater than* (>) and *less than* (<). Some candidates gave the answer which shows where f is increasing, e.g. their answer was $x < -3,62$ or $x > 2,95$. Some candidates gave their answer as $x > -3,62$ or $x < 2,95$ instead of $x > -3,62$ and $x < 2,95$. Some candidates left this question unanswered.

Suggestions for improvement

(a) Revision of the real number system is strongly advised to assist learners with the understanding of the order of numbers including notation used to indicate *greater than* or *less than*.

(b) Although the drawing of graphs is required, teachers need to include interpretation when teaching functions. Teachers should explain and demonstrate to learners where the graph is increasing, constant and decreasing with the aid of the diagrams. The use of software, like *GeoGebra* and *Geometry Sketch Pad and Graph* can be useful when teaching functions.

(c) The concept of the derivative function and the turning point should be explained in detail. Teachers need to emphasise that the derivative function is equal to zero at the turning points. Teachers should indicate to learners that calculating the *x*-coordinate of the turning point using $x = -\frac{b}{2a}$ only applies to quadratic functions.

(d) Teachers should explain the concept of *minima* and *maxima* (optimisation) thoroughly. They should demonstrate and explain to learners where the graph is increasing, constant or decreasing using diagrams.

(e) Learners should be thoroughly taught how to identify the portion of the graph where $f(x) < 0$, $f(x) \leq 0$, $f(x) > 0$ and $f(x) \geq 0$. They should be taught that the graph is increasing within an interval in which it is upward sloping $[f'(x) > 0]$ and decreases within an interval in which it is downwards sloping $[f'(x) < 0]$. Where $f'(x) = 0$, the function is neither increasing nor decreasing and that is why $f'(x) = 0$ is used to determine the x- coordinates of the stationary points.

QUESTION 8: APPLICATION OF CALCULUS

Common errors and misconceptions

(a) In Q8.1 many candidates did not realise that for the company that closed for a week, there was no production, i.e. $x = 0$; they assumed random values of x and substituted into $P(x)$. Some candidates gave their answer as a negative value; they did not

comprehend that a negative sign means a loss.

(b) A few candidates omitted the negative sign in the derivate to have $P^{/}(x)=20x^2+6000$ in Q8.2.

(c) In Q8.3 many candidates did not realise that they needed to equate the derivative to 0 to solve for x and then substitute the value in P(x). Many candidates failed to choose the correct value of x that will maximise the profit, they instead chose the incorrect value $x=10$. A few failed to complete the solution and substitute the value of x in P(x) to get the maximum profit. This shows limited understanding of when a profit is maximised or minimised.

Suggestions for improvement

(a) Learners should be exposed to as many contextual application questions testing the concepts of optimisation as possible. These should include rate of change, calculus of motion etc.

(b) Teachers should thoroughly demonstrate and explain to learners what is required when one gets maximum or minimum value, using different questioning strategies in test and non-test items.

(c) The use of different formulae involving solids, cones and pyramids on real-life applications need to be encouraged.

(d) Learners should be encouraged to read the problem to understand the different parts that would yield the required solution.

QUESTION 9: INTEGRATION

Common errors and misconceptions

(a) In Q9.1.1 some candidates integrated incorrectly; they wrote the integral as $\frac{6}{x}\,dx$. A few candidates omitted *C* when writing the indefinite integral. Instead of integration, some candidates differentiated the function.

(b) In Q9.1.2 some candidates failed to follow the procedure of removing the brackets first before integrating the function. Some did not fully simplify their integral.

(c) Many candidates failed to get the $\int 2^x dx$ in Q9.2.1. They gave their response as $\int 2^x dx=\frac{2^x}{Inx}+C$ or $\int \frac{2^x}{2\ln x}\,dx$ or $\int \frac{2^x}{x\ln 2}\,dx$. This clearly showed that they did not understand the rule, despite its being included in the information sheet provided with the question paper.

(d) In Q9.2 some candidates failed to identify and use correct boundaries. They were also unable to write the correct notation for area when using integrals. A few candidates substituted the boundaries in the given function without integrating the function first. Many candidates swopped the upper and lower limits and neglected to change negative area to a positive value. Some candidates did not realise that there were two shaded areas; they only calculated the area of one shaded part. A few

candidates correctly worked out the area of A to be $1{,}08$ units^2 and the area of B to be $5{,}34$ units^2 but no verification was shown to prove that the candidates' claims were valid.

Suggestions for improvement

(a) Learners should be reminded to refer to the information sheet at the back of the question paper and pay attention to 'C', the constant C must always be added.

(b) Teachers should emphasise to learners that in definite integrals, the given function must be integrated before substituting the limits.

(c) The difference between *differentiation* and *integration* should be explained and demonstrated thoroughly to learners. Correct use of integral notation should be emphasised.

(d) In the teaching of integration, learners should be taught to include the lower and upper boundaries when setting up the area notation for definite integrals. The use of brackets when substituting negative values must be emphasised.

(e) The calculation of the area bounded by a function and the x-axis should be demonstrated so that learners can observe how the value of the constant influences the area.

(f) Teachers must emphasise to learners that it should not be a habit to add two different areas as the question might require comparing one area to another. Learners should be exposed to a variety of applications involving integration to enhance their understanding of the concept of integration. They should be encouraged to always draw up conclusions in response to the questions asked in the given scenarios.

2.5 ANALYSIS OF CANDIDATES' PERFORMANCE IN EACH QUESTION IN PAPER 2

(a) Candidates performed relatively well in questions assessing concepts in Analytical Geometry and Trigonometry topics that are taught in the lower grades.

(b) In the question assessing circles, angles and angular movement, candidates performed well.

(c) Candidates performed poorly in questions that assessed Euclidean Geometry and Measurement.

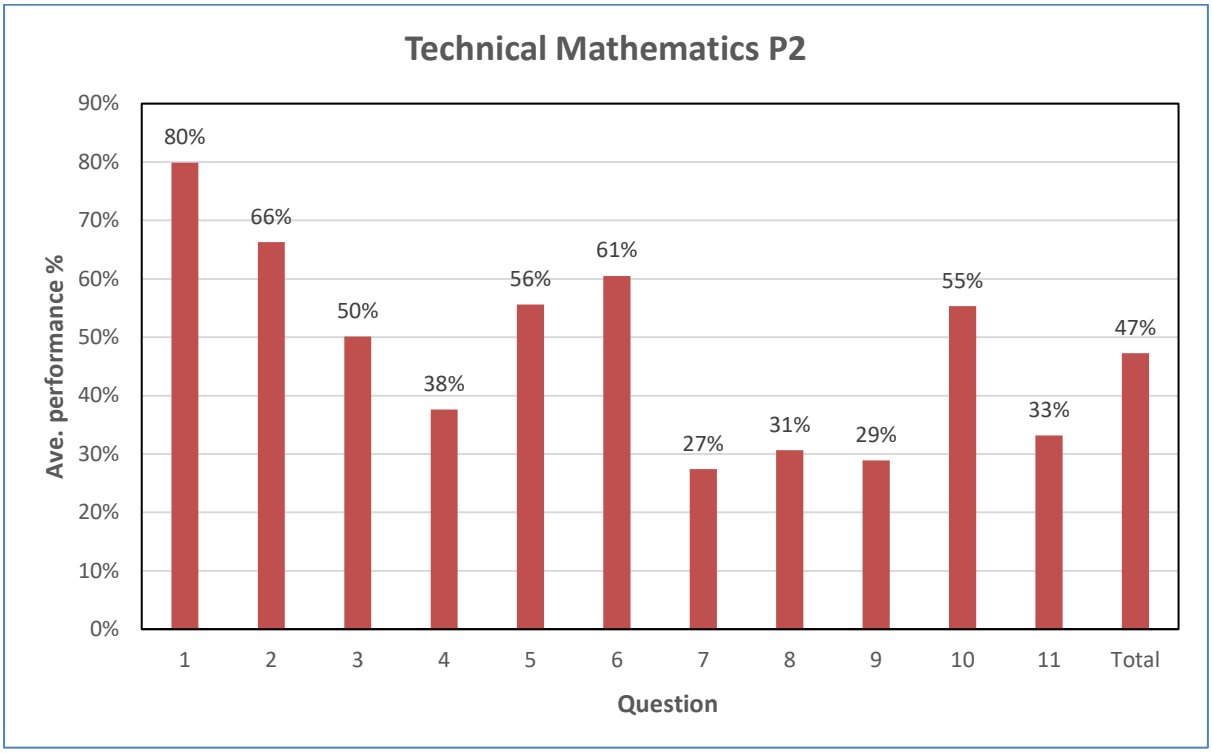
(d) Candidates were challenged by questions requiring higher-order reasoning. This is an indication that they might not have been fully exposed in these types of questions.

(e) It was evident that many of the errors made by candidates in answering the questions in this paper had their origins in a poor understanding of the basics and the foundational skills taught in the lower grades.

2.6 DIAGNOSTIC QUESTION ANALYSIS OF PAPER 2

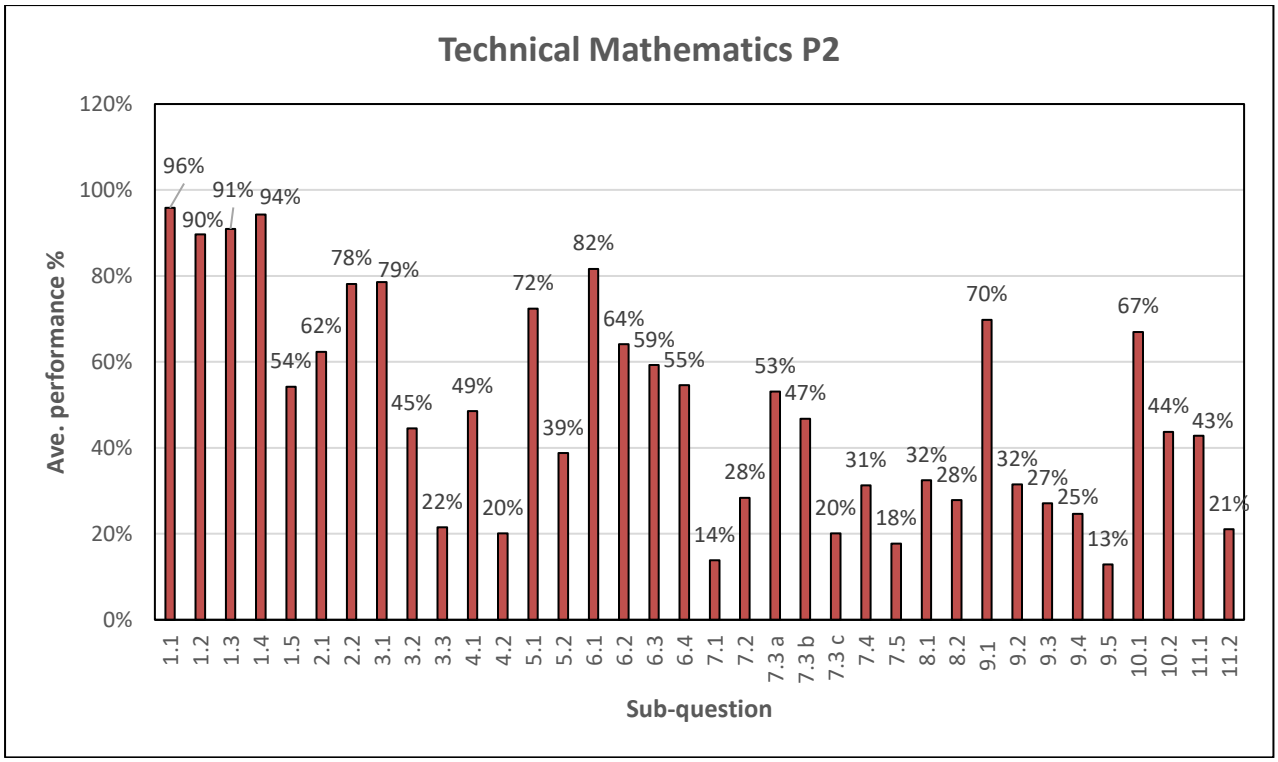
The following graph is based on data from a random sample of candidates. While this graph might not accurately reflect national averages, it is useful to assess the relative degrees of challenge of each question as experienced by candidates.

Graph 2.6.1 Average performance per question in Paper 2



Question	Topic
1	Analytical Geometry - Length, Gradient etc.
2	Analytical Geometry - Circles, Tangents and Ellipse
3	Trigonometry- ratios
4	Trigonometry- identities
5	Trigonometry- functions and graphs
6	Trigonometry- 2D and 3D
7	Euclidean Geometry - Circles
8	Euclidean Geometry - Circles
9	Euclidean Geometry - Proportion and Similarity
10	Circles, Angles and Angular velocity
11	Measurement

Graph 2.6.2 Average performance per subquestion in Paper 2



2.7 ANALYSIS OF CANDIDATES' PERFORMANCE IN EACH QUESTION IN PAPER 2

QUESTION 1: ANALYTICAL GEOMETRY

Common errors and misconceptions

(a) In Q1.1 some candidates wrote the correct formula from the information sheet for the gradient, but then swopped the x and y coordinates when they substituted into the formula, for example:

$m_{AC} = \frac{y_C - y_A}{x_C - x_A} = \frac{4-6}{-4-0}$ instead of $\frac{-4-0}{4-6}$

(b) In Q1.5 many candidates confused the concept of the gradient of parallel lines with that of perpendicular lines. After correctly determining the gradient of line AC as 2 in Q1.1 many candidates mistakenly concluded that the gradient of the perpendicular bisector must be either 2 or – 2, rather than the correct value of $-\frac{1}{2}$.

(c) In Q1.5 a common mistake occurred when candidates substituted the gradient and coordinates but made errors while solving for c as the subject of the formula.

$$-2 = -\frac{1}{2}(5) + c$$

C instead of -C

$$c = -\frac{5}{2} + 2$$

$$c = -\frac{1}{2}$$

Suggestions for improvement

(a) The lack of basic knowledge still needs attention. Learners need to know that the gradient of parallel lines are equal and that the product of the gradients of perpendicular lines are equal to minus one.

(b) Teachers should make learners write frequent short tests at the beginning of the lesson. These tests should ask learners to write down the formula for the gradient of a line, the distance formula etc. These are basic concepts that they need to know.

QUESTION 2: ANALYTICAL GEOMETRY

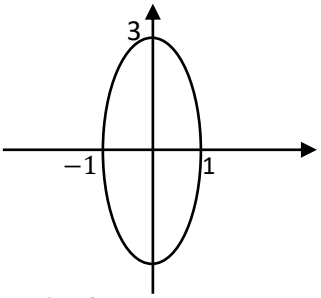
Common errors and misconceptions

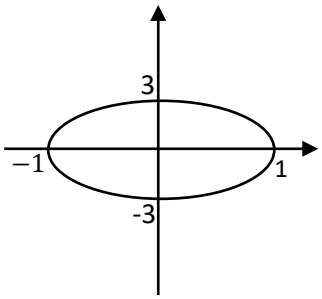
(a) In Q2.1.2 candidates had to use the value of r^2 from Q2.1.1 to determine the value of r and then to get the value of the x coordinate of S. Many candidates did not use the value calculated in Q2.1.1. They did not recognise that the x-intercept has $y = 0$.

(b) In Q2.1.3 lack of basic knowledge was problematic. Very few candidates could state that the radius is perpendicular to the tangent. Many candidates used the gradient for the radius as the gradient for the tangent.

(c) In Q2.2.1 candidates were expected to write an equation of an ellipse in standard form. Most candidate committed a simple error, $\frac{x^2}{1^2}+\frac{y^2}{3^2}$ instead of $\frac{x^2}{1^2}+\frac{y^2}{3^2}=1$.

(d) Although candidates used a different scale to draw the ellipse in Q2.2.2, both the answers were valid because of different scales:





Suggestions for improvement

(a) Revision of the work taught in earlier grades is strongly advised.

(b) Teachers must emphasise that the equation of a circle is not included on the information sheet. This question is supposed to be a routine procedure for the learners to identify and use the correct formula, but many learners use the equation of a straight line or an ellipse.

(c) The skill of expressing the equation of an ellipse in standard form is basic drill work.

QUESTION 3: TRIGONOMETRY

Common errors and misconceptions

(a) Using the calculator to find the reciprocal ratio in Q3.1.2 was still a challenge for most candidates.

(b) In Q3.1.3 most candidates made the mistake of mixing radians and degrees when substituting the values for angles A and B.

(c) In Q3.2.2 a few candidates did not complete the accompanying diagram to answer the question. A common mistake occurred when candidates substituted the ratio but incorrectly retained the trigonometric function, for example, they wrote $1 + \sin\left(\frac{12}{13}\right)^2$ instead of $1 + \left(\frac{12}{13}\right)^2$.

(d) In Q3.3 most candidates approached the equation $2\sin x = 3\cos x$ by manipulating it to work exclusively with either $\sin x$ or $\cos x$, instead of dividing through by $\cos x$ / $2\cos x$ or $\sin x$ / $2\sin x$ to express it as a tangent ratio.

Suggestion for improvement

(a) Teachers must emphasise the settings of the calculator between degrees and radians.

(b) Learners must be taught to first substitute the given values into the expression before attempting to find the reciprocal. It is important to understand that even if the reciprocal is incorrect, a mark can still be achieved for correctly performing the substitution step.

(c) Teachers should emphasise that, when substituting angle values into trigonometric expressions, both angles must be in the same unit – either both in degrees or both in radians. If learners choose to work in radians, they must ensure that their calculator is set to radian mode. However, this can cause complications, as most trigonometry problems are typically based on degrees. To avoid confusion, learners to should be encouraged to use degrees; this will ensure consistency throughout the question.

(d) Teachers should focus on reinforcing the relationships between sec and cos, sine and cosec, as well as tan and cot in class.

(e) Learners should be encouraged to complete the diagram on the Cartesian plane right from the start of the question. They must label the given values on the diagram and use Pythagoras to calculate the unknown side.

(f) As there might be fewer examples of these types of equations in all the textbooks, teachers need to source additional examples for learners.

QUESTION 4: TRIGONOMETRY

Common errors and misconceptions

(a) In Q4.1.1 and Q4.1.2 most candidates struggled with the basic reduction formulae that they were expected to answer.

(b) In Q4.2.1 many candidates could not complete the identity.

(c) In Q4.2.2 most candidates struggled to determine the lowest common denominator (LCD), and therefore, could not prove the identity.

Suggestions for improvement

(a) The mastering of the correct use of the CAST diagram to determine whether a trigonometric ratio is positive or negative in each quadrant must be emphasised.

(b) Teachers must highlight the importance of using the information sheet to apply key trigonometric identities, such as:

$$\sin^2\theta + \cos^2\theta = 1$$
$$1 + \tan^2\theta = \sec^2\theta$$
$$1 + \cot^2\theta = cosec^2\,\theta$$

(c) Learners need to practise rearranging these identities to make a specific variable the subject, for example $1 - \sin^2\theta = \cdots$.

QUESTION 5: TRIGONOMETRY

Common errors and misconceptions

(a) In Q5.1.1 many candidates drew the graph of $y = 2\sin x$ instead of $y = \sin 2x$.

(b) Many candidates incorrectly expressed the period of g as an interval, such as $(0°; 180°)$, in Q5.2.1. This notation is incorrect.

(c) Q5.2.2 asked for TWO values of x for which $f(x) = g(x)$. In this case, some candidates also wrote the answer in interval notation, for example, $(0°; 45°)$ instead of $x = 0°; x = 45°$.

(d) Many candidates found Q5.2.4 challenging because of its higher level of complexity; as a result, they struggled to provide the correct answer.

Suggestions for improvement

(a) Teachers must not only focus on drawing the trig graphs, but also spend more time teaching learners how to interpret the graph.

(b) Grade 11 work needs regular practice.

(c) Special attention needs to be given to correct notation.

(d) Teachers must emphasise basic theory like period, amplitude, etc.

QUESTION 6: TRIGONOMETRY

Common errors and misconceptions

(a) In Q6.2 – Q6.4 the most errors occurred when candidates incorrectly used values or sides from different triangles and substituted them into the sine rule or the area rule to calculate the length of a side in a specific triangle. This approach was invalid, as

the rules apply only within the same triangle, and such errors resulted in incorrect calculations and a breakdown in the solution process.

Suggestions for improvement

(a) Learners must know:
- Sine rule: The emphasis should be on identifying the triangle to work in and being able to use the given information in that triangle.
- Area rule: This rule can only be applied when two sides and the included angle are used.
- The included angle must be calculated if not given.

QUESTION 7: EUCLIDEAN GEOMETRY

Common errors and misconceptions

(a) Most candidates gave random, unrelated reasons when required to substantiate their statements.

(b) It was evident that most candidates lacked basic theorem knowledge. They struggled to phrase their reasoning correctly as was seen in Q7.1 and Q7.3.

(c) It was clear in Q7.4 that many candidates did not know the 4 cases of congruency.

(d) For many candidates, the proving of a cyclic quadrilateral in Q7.5 was very confusing.

Suggestions for improvement

(a) Learners should be drilled on stating theorems in full when they are engaging with questions on Euclidean Geometry.

(b) The *2021 Examination Guidelines* which provides acceptable reasons should become a working document when teaching this topic. Learners must be encouraged to use the wording of reasons as they appear in the *Examination Guidelines*.

(c) Learners should be encouraged to use and work on the given diagram in the answer book to track their path of reasoning regarding the angles.

QUESTION 8: EUCLIDEAN GEOMETRY

Common errors and misconceptions

(a) Most candidates were unable to scrutinise the given information and logically unpack the information that would lead to the solution.

(b) Candidates struggled to identify the correct exterior angle of the cyclic quad.

(c) Most candidates still struggled to apply Circle Geometry theorems when a combination of these theorems was required to answer a question.

Suggestions for improvement

(a) Learners are encouraged to revisit Circle Geometry which is a Grade 11 topic and thoroughly revise all the basic theorems.

(b) It is essential for teachers to guide learners in using subscripts or three-letter notations to name angles, especially when the angle is part of a more complex diagram.

(c) Diagrams are provided in the answer book and learners must be encouraged to indicate all given and determined information on the diagram.

(d) Learners should be taught that all statements must be accompanied by reasons. Statements must be logical and lead to solving the problem. It must become a habit for learners to indicate and add information on their diagrams as they unpack and solve riders in sub-questions.

QUESTION 9: EUCLIDEAN GEOMETRY

Common errors and misconceptions

(a) In Q9.1 candidates either did not understand the symbols used to indicate equal length and/or they did not read the given information.

(b) In Q9.2 candidates did not know how or which reason to use and sometimes gave an incomplete reason, e.g. most candidates wrote 'prop theorem' and did not include the parallel lines.

(c) In Q9.4 and Q9.5 candidates struggled with the concepts of proportionality and similarity. Candidates could not identify the correct sides to use when determining the ratios in similar triangles.

Suggestion for improvement

(a) The correct naming of sides in identifying ratios must be stressed.

(b) Similarity and congruency should be revised.

(c) Teachers should continue to expose learners to different ways of applying proportionality theorems even when the triangle has more than one pair of parallel sides given. They should be taught to view each triangle separately first, apply theorems and then look for connections.

QUESTION 10: CIRCLES, ANGLES AND ANGULAR MOVEMENT

Common errors and misconceptions

(a) In Q10.1.1 and Q10.1.2 most candidates could not convert to the correct unit.

(b) Most candidates could identify the correct formula and the correct substitution in Q10.2.2 but they struggled to convert the answer to the correct units, or they substituted the angle in degrees rather than in radians.

(c) In Q10.1.5 candidates did not realise that units need conversion, and substituted the length of the radius in metres.

(d) Integration of topics in Q10.2.4 caused significant problems for all candidates. In

these questions, candidates were required to apply the cosine rule to determine the central angle before determining the arc length and most candidates could not do that.

Suggestions for improvement

(a) Teachers should revise basic conversions between different units must be emphasised and practised on a regular basis.

(b) Learners should be able to relate each variable in the formula to what it represents to avoid incorrect substitution. Learners should be exposed to exercises where formulae are manipulated to determine other variables within the formulae.

(c) Formula sheets should be pasted in the learners' daily activities books and effectively used during teaching from Grade 10.

QUESTION 11: MENSURATION

Common errors and misconceptions

(a) In Q11.1.3 and Q11.2.1 most candidates gave the generic version of the formula instead of adapting it to suit the question.

(b) In Q11.2.2 and Q11.2.3 candidates confused the slant height with the perpendicular height.

(c) In Q11.1.3 some candidates copied the mid-ordinate formula incorrectly and even when they copied this formula correctly, they were still unsure about how to interpret the o_{n-1}. They all subtracted 1 from the ordinates and got the incorrect area.

(d) In Q11.2.1 most candidates did not exclude one of the six faces of the rectangular prism that was not part of the exterior.

Suggestions for improvement

(a) Teachers should explain the formula carefully before application. This will help learners to apply the formula with understanding.

(b) Learners' regular exposure to real-life problems will enhance the understanding of these types of measurement problems.

(c) Teachers need to coach learners to adapt formulae for Total Exterior Area to exclude surfaces which are not part of the exterior. There are almost always faces to be excluded when a composite shape is involved.

CHAPTER 3

TECHNICAL SCIENCES

The following report should be read in conjunction with the Technical Sciences question papers of the NSC November 2024 examinations.

3.1 PERFORMANCE TRENDS (2020–2024)

The number of candidates who sat for the Technical Sciences examinations in 2024 increased by 591, compared to that of 2023.

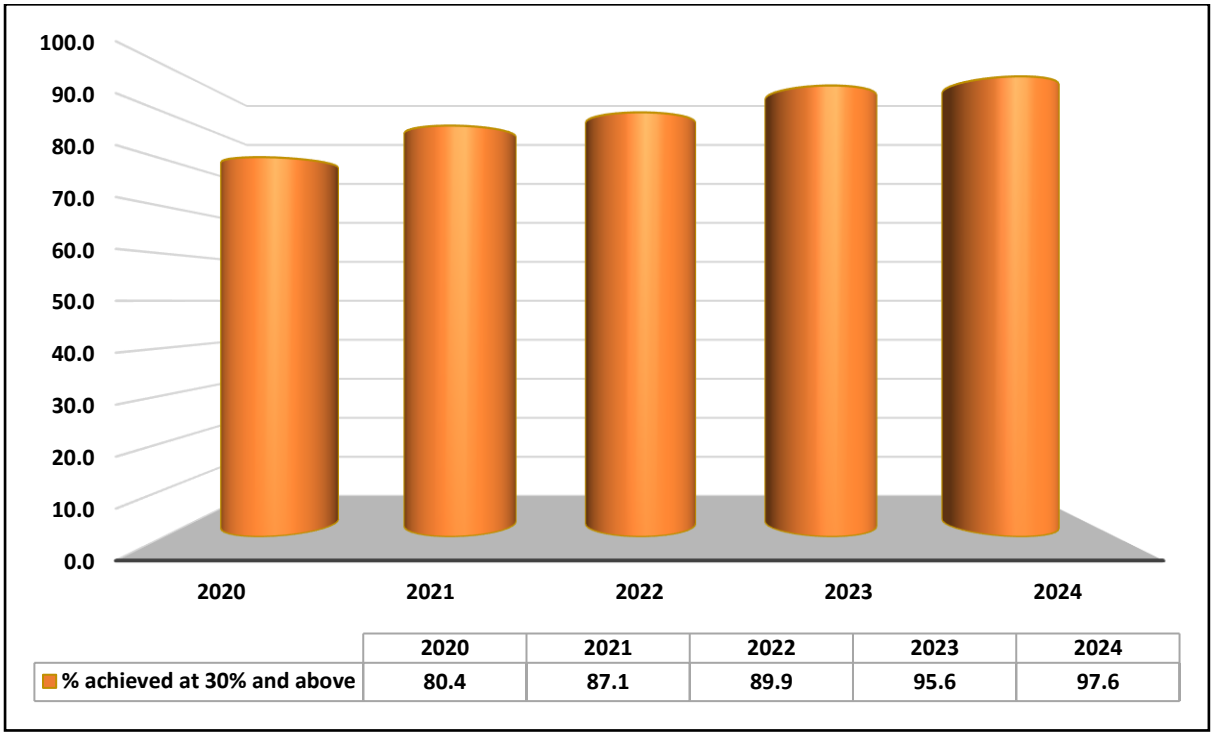
There was a marginal improvement in the pass rate this year. Candidates who passed at the 30% level improved from 95,6% in 2023 to 97,6% in 2024. The percentage of distinctions over 80% improved from 0,7% in 2023 to 1% in 2024. Given the increase in the size of the 2024 cohort, this converts into an increase in the total number of distinctions from 114 to 173.

The various commendable intervention strategies employed by teachers, subject advisors and provincial education departments were continued in 2024. The resourcefulness and diligence of the above-average candidates also contributed to the overall improvement in the subject.

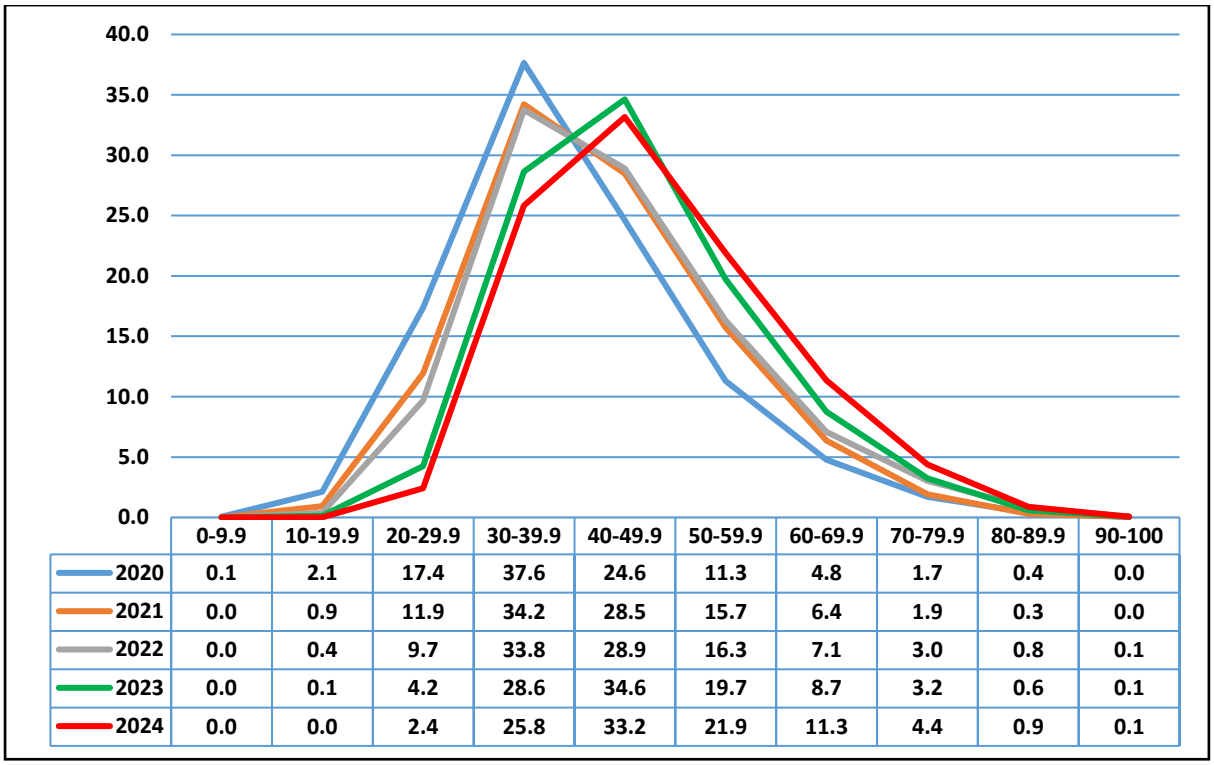
Table 3.1.1 Overall achievement rates in Technical Sciences

Year	No. wrote	No. achieved at 30% and above	% achieved at 30% and above
2020	11 655	9 375	80,4
2021	14 642	12 758	87,1
2022	15 753	14 168	89,9
2023	16 322	15 609	95,6
2024	17 273	16 854	97,6

Graph 3.1.1 Overall achievement rates in Technical Sciences (percentage)



Graph 3.1.2 Performance distribution curves in Technical Sciences (percentage)



	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	90-100
2020	0.1	2.1	17.4	37.6	24.6	11.3	4.8	1.7	0.4	0.0
2021	0.0	0.9	11.9	34.2	28.5	15.7	6.4	1.9	0.3	0.0
2022	0.0	0.4	9.7	33.8	28.9	16.3	7.1	3.0	0.8	0.1
2023	0.0	0.1	4.2	28.6	34.6	19.7	8.7	3.2	0.6	0.1
2024	0.0	0.0	2.4	25.8	33.2	21.9	11.3	4.4	0.9	0.1

3.2 OVERVIEW OF CANDIDATES' PERFORMANCE IN PAPER 1

General comments

(a) The multiple-choice items in Q1 and the questions on Newton's laws (Q2) and work, energy and power (Q4) as well as hydraulics (Q6) were generally well answered.

(b) In general, Q5, Q7, Q8 and Q9 were poorly answered. Q5 focused on elasticity; Q7 examined refraction and reflection of light; Q8 dealt with electromagnetic radiation and lenses, and Q9 was based on electric circuits and capacitors.

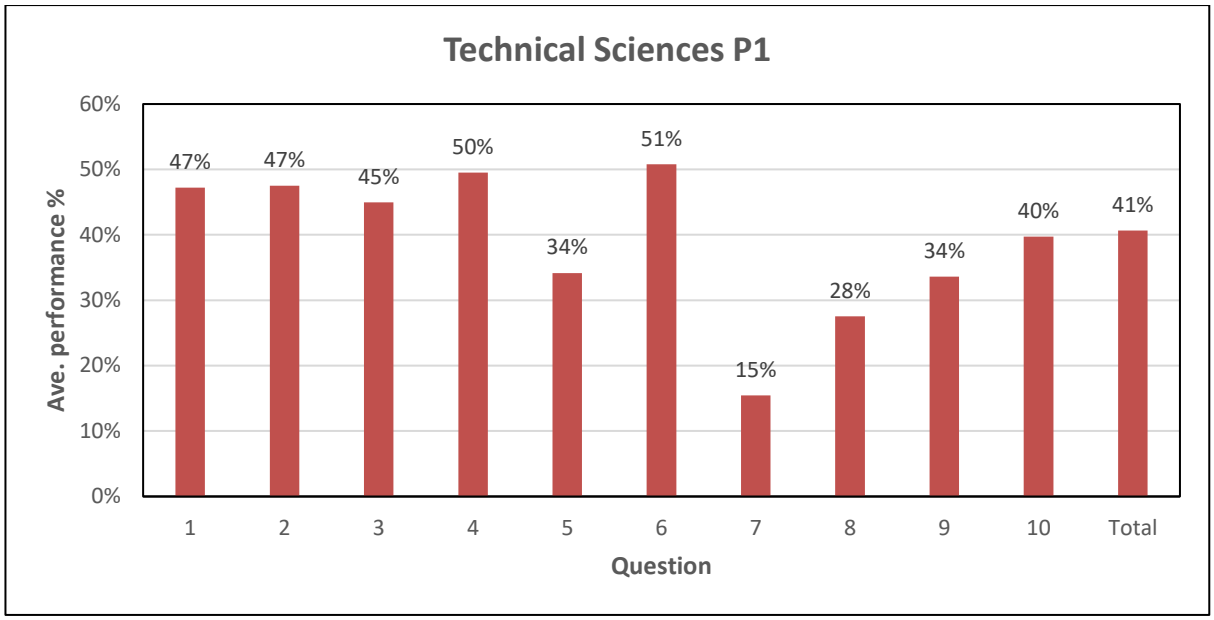
(c) A notable number of candidates still struggled with recall questions, however, there is a significant improvement in answering these types of questions.

(d) It is worth noting that some candidates lacked mathematical skills; as such they had difficulty using formulae and scientific notation, and interpreting and representing direction in terms of a negative and positive sign. Therefore, there is a need to focus on conceptual understanding, mathematical skills, unit conversion, integration of topics, problem-solving skills and practical work.

3.3 DIAGNOSTIC QUESTION ANALYSIS OF PAPER 1

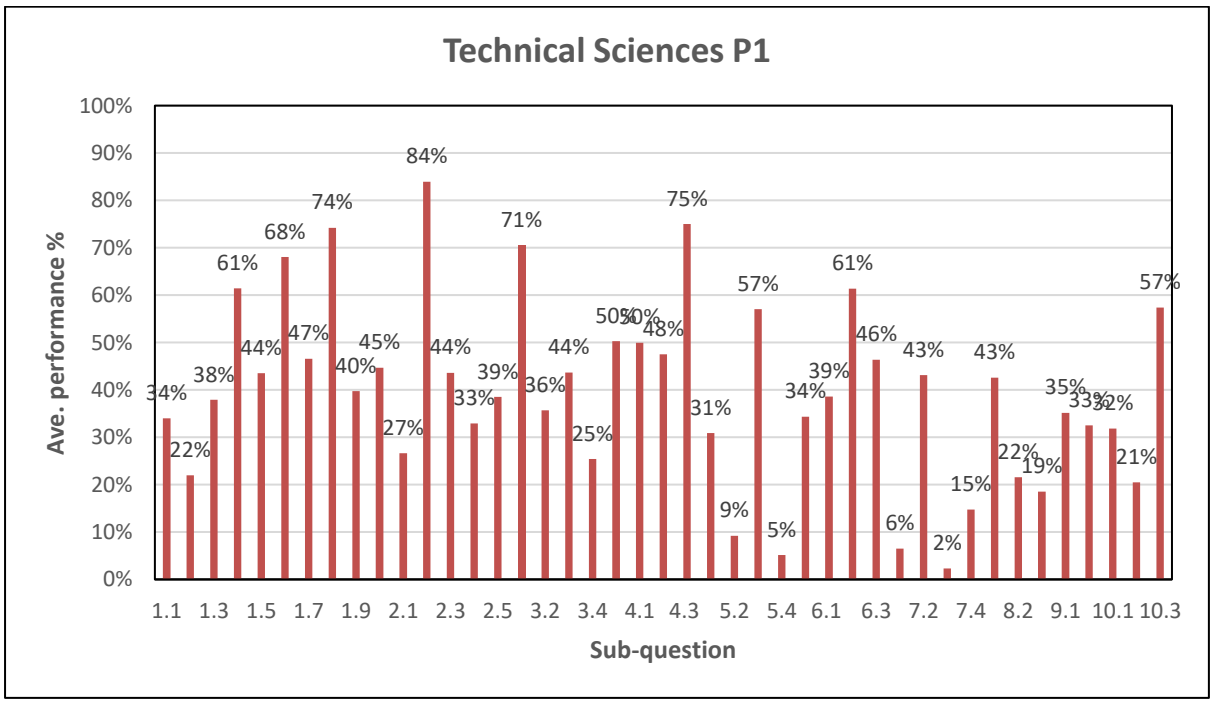
The following graph is based on data from a random sample of candidates. While this graph might not accurately reflect national averages, it is useful in assessing the relative degrees of challenge of each question as experienced by candidates.

Graph 3.3.1 Average performance per question in Paper 1



Q	Topic	Q	Topic
1	MCQ	6	Hydraulics
2	Newton's laws (Forces)	7	Light: Reflection and refraction
3	Momentum and impulse	8	Light: Electromagnetic radiation and lenses
4	Work, energy and power	9	Electric Circuits and Capacitors
5	Elasticity	10	Generators, motors and transformers

Graph 3.3.2 Average performance per subquestion in Paper 1



3.4 ANALYSIS OF CANDIDATES' PERFORMANCE IN EACH QUESTION IN PAPER 1

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Common errors and misconceptions

(a) A notable number of candidates seemed to guess the answers instead of working out the correct options.

(b) A significant number of candidates had difficulty defining a *net force* in terms of momentum in Q1.1.

(c) Q1.2 was the most poorly answered question, because most candidates were challenged when having to state what will happen to the block if two unequal forces are applied simultaneously to the block.

(d) The majority of candidates had difficulty understanding a relationship between the *mass* of an object and its *acceleration* in Q1.3. They could not show that when the mass is doubled, the acceleration will be halved if the same net force acts on an object.

(e) In Q1.5 a significant number of candidates struggled to interpret the graph by stating a relationship between *viscosity* and *fluid temperature*.

(f) In Q1.7 most candidates failed to state that the physical phenomena taking place when white light is passed through a triangular glass prism are *refraction* and *dispersion*.

(g) A notable number of candidates had difficulty determining the equivalent unit of farad by referring to the formula on the formula sheet in Q1.9.

Suggestions for improvement

(a) MCQ must be integrated into daily teaching and learning. Teachers must infuse MCQ into both formal and informal assessment. Additionally, they must insist that learners provide a reason for their choice, and address any misconception.

(b) Subject advisors and lead teachers must update a per-topic booklet of MCQ using previous NSC and Preparatory Examinations question papers. They must ensure that teachers utilise this booklet.

(c) Learners must be encouraged to make use of the formulae to:
- Determine the relationship between variables
- Recall the laws and principles
- Determine the equivalent SI units

(d) Teachers should focus on the drawing and interpretation of graphs. Formulae must also be used to analysed and interpret graphs.

(e) Informal and PAT experiments must be done to reinforce learner understanding. Simulations can be used in cases where there is no apparatus or/and reagents for the experiment.

QUESTION 2: NEWTON'S LAWS OF MOTION

Common errors and misconceptions

(a) Q2.1 was the question in which most candidates performed poorly as most candidates had difficulty naming and stating Newton's law that was applicable to a given scenario. The majority of candidates who attempted to name and state the correct law omitted key words like 'simultaneously', 'equal magnitude' and 'oppositely directed'.

(b) In Q2.2 a notable number of candidates committed the following errors when drawing a free-body diagram:
- Used lines instead of arrows
- No dot drawn to represent the object or drawing a small circle instead of a dot.
- Leaving gaps between the dot and the lines
- Drawing dotted lines instead of solid lines
- Drawing a force diagram instead of a free-body diagram
- Drawing an extra force

(c) When asked to define a *frictional force* in Q2.3, a significant number of candidates omitted key words like 'opposes the motion' and 'parallel to the surface'. Some defined friction as 'the force that opposes the applied force'.

(d) The majority of the candidates got Q2.4 wrong as they had difficulty calculating *tension*. They did not take into account the vector nature of forces in terms of representing an opposite direction with a negative sign. Some started by calculating *acceleration* as they were not aware that when an object is moving at constant velocity its acceleration is zero.

(e) Most candidates had difficulty explaining what will happen to the car when the tow bar is detached from the car in Q2.5.1. Some only wrote 'it will continue moving forward' without stating that 'it will continue moving forward and slow down' or 'it will continue moving forward and eventually come to rest'.

(f) In Q2.5.2 a significant number of candidates substituted the mass of a bakkie instead of that of a car. A good number of candidates wrote an incorrect SI unit for acceleration.

Suggestions for improvement

(a) When drawing free-body diagrams, teachers must emphasise the use of labelled arrows and acceptable labels or abbreviations. The use of broken or dotted lines must be discouraged. The number of forces must correlate with the mark allocation.

(b) Learners must be encouraged to use the definitions and laws as stated in the *Examination Guidelines*. Definitions, laws and principles must be displayed in the classroom.

(c) Defining terms and stating principles or laws must be infused in all forms of assessment.

(d) Multi-step problems including those that involve two body systems must be incorporated into informal assessment and learners must be given feedback before writing formal tasks.

(e) Learners must be exposed to high-order questions that involves explaining, justifying, evaluating, etc. They must also be encouraged to use formulae to explain the relationship between variables.

(f) Teachers must refrain from using unconventional abbreviations of SI units, like 'sec' for seconds.

QUESTION 3: MOMENTUM AND IMPULSE

Common errors and misconceptions

(a) Q3.1 was well answered, however, a notable number of candidates omitted keywords like *total*, *linear* or *isolated system* when stating the principle of conservation of linear momentum.

(b) In Q3.2 most candidates wrote the incorrect formula as they did not realise that the bullet was inside the gun before explosion and the bullet and the gun were only separated after explosion. Other candidates wrote incorrect formulae like: $p_{before} = p_{after}$ or $\Sigma Ek_i = \Sigma Ek_f$ instead of $\Sigma p_i = \Sigma p_f$. Some candidates omitted direction on the final answer.

(c) A notable number of candidates had difficulty identifying the type of explosion in Q3.3.

(d) Q3.4 posed a serious challenge to most candidates as they did not realise that they had to compare the mass of a bullet to that of a gun-trolley system when explaining their answers. Some candidates used the formula 'p = mv' instead of '$\Delta p = mv_f - mv_i$'.

(e) In Q3.5.1 a significant number of candidates had difficulty identifying the initial and final velocities. Some did not include the direction in the final answer. Others did not choose a direction which is positive and the one which is negative during the substitution for initial and final velocities. A notable number of them could not convert g to kg as was required of them.

(f) In Q3.5.2 most candidates used different signs, i.e. a positive and a negative sign for Δp and F_{net}, as they did not realise that these variables are pointing in the same direction. A good number of candidates wrote 'sec' instead of 's' for SI unit of seconds.

Suggestions for improvement

(a) Teachers must train learners to define terms and state laws and principles without omitting key words.

(b) Teachers must also focus on sign conversion when dealing with calculations involving vector quantities. Learners must be encouraged to include the units and direction in the final answer to these calculations.

(c) Conversion of units and the use of scientific notation must be integrated into all forms of assessment.

(d) Teachers must perform formal and informal experiment(s) to reinforce learner understanding of the concepts.

QUESTION 4: WORK, ENERGY AND POWER

Common errors and misconceptions

(a) A notable number of candidates committed the following errors in a free-body diagram in Q4.1.1:
- Used lines instead of arrows
- No dot drawn to represent the object
- Leaving gaps between the dot and the lines
- Drawing dotted lines instead of solid lines
- Drawing an extra force

(b) A good number of candidates wrote an incorrect unit for work in the final answer to Q4.1.2.

(c) In Q4.2.1 a significant number of candidates defined *power* as a ratio of work done and time.

(d) A notable number of candidates forfeited a mark for being unable to convert the given mass of an egg from g to kg and the height from cm to m in Q4.2.3 and Q4.2.4.

(a) In Q4.2.2 the majority of the candidates omitted key words when stating the *principle of conservation of mechanical energy*. Some of the common errors included omitting the words 'total' or 'isolated'. A good number of Afrikaans candidates wrote 'geslote' instead of 'geïsoleerde'. There were some English candidates who wrote 'closed' instead of 'isolated'.

(e) In Q4.2.4 most candidates attempted to calculate the kinetic energy of an egg when it had fallen half way instead of deducing its value from the previous subquestion as only 1 mark was allocated for this question.

(f) A substantial number of candidates omitted the subscripts 'top' and 'bottom' in the formula $(M_E)_{top} = (M_E)_{bottom}$ in Q4.2.5.

Suggestions for improvement

(a) Learners must be taught that drawing and mastery of the free-body diagram is key to problem solving. Use of labelled arrows must be emphasised. The number of forces must correlate with the mark allocation.

(b) Teachers must drill the learners to state the laws or principles and define the terms as they are stated in the *Examination Guidelines*.

(c) Encourage learners to analyse the given information carefully and to extract the necessary information to choose the correct formula from the formula sheet.

(d) Teachers must also incorporate unit conversion into daily teaching and learning.

QUESTION 5: ELASTICITY

Common errors and misconceptions

(a) A significant number of candidates omitted key words when defining elasticity in Q5.1. Other candidates used the word 'product' instead of 'property'. Some candidates

defined a perfectly elastic body instead of elasticity.

(b) In Q5.2 most of the candidates struggled to write down the significance of Young's modulus of elasticity. A good number of candidates defined Young's modulus of elasticity. Some of the candidates did not attempt this question.

(c) In Q5.3.1 and Q5.3.2 a significant number of candidates had a challenge of reading the values from the graph. Some attempted to calculate strain, not realising that they had to read it from the graph.

(d) Most candidates had difficulty explaining what a difference in values of moduli of elasticity of the two materials indicates about their nature in Q5.4.

(e) In Q5.5.1 a significant number of candidates confused elastic region with elastic limit.

Suggestions for improvement

(a) Teachers must expose learners to open-ended and application questions in informal assessment. Remedial work must be done before learners write formal tasks.

(b) Definitions must be infused into daily teaching and learning to reinforce understanding of concepts. Teachers must explain concepts thoroughly.

(c) Drawing and interpretation of graphs must be integrated into daily teaching and learning.

QUESTION 6: HYDRAULICS

Common errors and misconceptions

(a) Most candidates omitted key words like 'continuous', 'in equilibrium' and 'transmitted equally' when stating *Pascal's law* in Q6.1. Some used the word 'distributed' instead of 'transferred'.

(b) In Q6.2 a significant number of candidates had difficulty converting cm^2 to m^2 with some candidates rounding off the values from the leading statement incorrectly before substituting it in the formula.

(c) In Q6.3.1 a substantial number of candidates had difficulty stating a factor that affects the fluid pressure at a given depth.

Suggestions for improvement

(a) Teachers must infuse the stating of laws into daily teaching and learning. Learners must be taught to understand the laws. However, laws must be stated as they appear in the *Examination Guidelines*.

(b) Learners must be taught what each variable, symbol or letter represents in a formula. A relationship between variables must be explained thoroughly.

(c) Unit conversion must also form part of daily informal assessment and formal tasks. Learners must be taught conversion skills.

(d) Learners must be taught to only round off the final answer and not intermediate values or values from the question or leading statement.

QUESTION 7: LIGHT (REFLECTION AND REFRACTION)

Common errors and misconceptions

(a) Most candidates had difficulty identifying, naming and defining the phenomenon taking place inside the diamond in Q7.1. Some confused total internal reflection for dispersion.

(b) In Q7.2.1 and Q7.2.2 a significant number of candidates struggled to compare the sizes of θ_4 and θ_5 (angle of incidence and angle of reflection) and provide a reason for their answers.

(c) Most candidates could not describe a critical angle in Q7.3. A notable number of them did not make mention of the value of the angle of refraction when answering this question. Some did not even attempt this question.

(d) In Q7.4.2 a notable number of candidates had difficulty writing what happens to a light ray at diamond-air interphase. Some wrote 'the light ray moves from a denser medium to a lesser denser medium' instead of 'the speed of light will increase and light ray will bend away from the normal'.

Suggestions for improvement

(a) This topic must be taught and assessed thoroughly using informal and formal assessment. Teachers must emphasise the difference between *dispersion*, *refraction* and *reflection*. Simulations must be used to explain these differences.

(b) Learners must be taught terminology and different phenomena of light as prescribed in the *CAPS* and examination guidelines.

(c) Teachers must teach learners to draw ray diagrams showing how a light ray behaves as it interacts with different media.

(d) Concepts like *critical angle*, *angle of refraction*, *angle of reflection* and *total internal reflection* must be emphasised. Use simulations to reinforce understanding.

(e) PED and District subject specialists must train teachers on effective use of simulations.

QUESTION 8: LIGHT (ELECTROMAGNETIC RADIATION AND LENSES)

Common errors and misconceptions

(a) In Q8.1.1 a notable number of the candidates had difficulty identifying the type of electromagnetic wave that is used to broadcast at a given frequency. Some wrote 'sound waves' instead of 'radio waves'.

(b) A good number of candidates struggled to calculate the energy of the electromagnetic wave in Q8.1.2. A significant number of those who managed to select the correct formula had a challenge to convert MHz to Hz.

(c) In Q8.2.1 most candidates had difficulty labelling different parts of the lens. Some labelled 'optical centre' as 'optical point'.

(d) A good number of candidates wrote 'concave lens' instead of 'convex lens' in Q8.2.2.

(e) In Q8.3 most candidates battled to write down properties of an image formed by a

convex lens when the object is placed between F and 2F. Some wrote 'twisted' instead of 'inverted'.

Suggestions for improvement

(a) Learners must be taught different types of electromagnetic waves and the relationship between frequency, wavelength and energy of these waves.

(b) Unit conversion must be infused into daily teaching and learning.

(c) Teachers must emphasise the drawing and labelling of lenses, placing the object in different positions. Learners must be assessed rigorously and teachers must do remedial work timeously to reinforce learning.

QUESTION 9: ELECTRIC CIRCUITS AND CAPACITORS

Common errors and misconceptions

(a) Most candidates battled to state the factors that affect capacitance in Q9.1.1. Some of the incorrect responses included 'area between the plates' or 'distance between the material' instead of 'distance between the plates' and 'size of the plates' instead of 'surface area of the plates'.

(b) In Q9.1.2 a notable number of the candidates struggled to convert pF to F.

(c) In Q9.2.1 a significant number of candidates omitted key words like 'rate' in a definition of *electric current*. A common incorrect response was 'electric current is a flow of electric charge'.

(d) A good number of candidates used the incorrect or unconventional units or abbreviations for *ampere* in Q9.2.2. Some wrote 'Amps' or 'Amplis' instead of 'amperes'.

(e) Most candidates struggled to explain why the bulb would burn out when a second speaker is connected across points G and H in Q9.2.3. Some candidates did not attempt this question.

(f) Q9.2.4 and Q9.2.5 were follow-up questions of Q9.2.3. Candidates had difficulty naming the component that must be connected to the circuit to prevent the bulb from burning out. A notable number of them could not explain how this component should be connected to prevent the bulb from burning out.

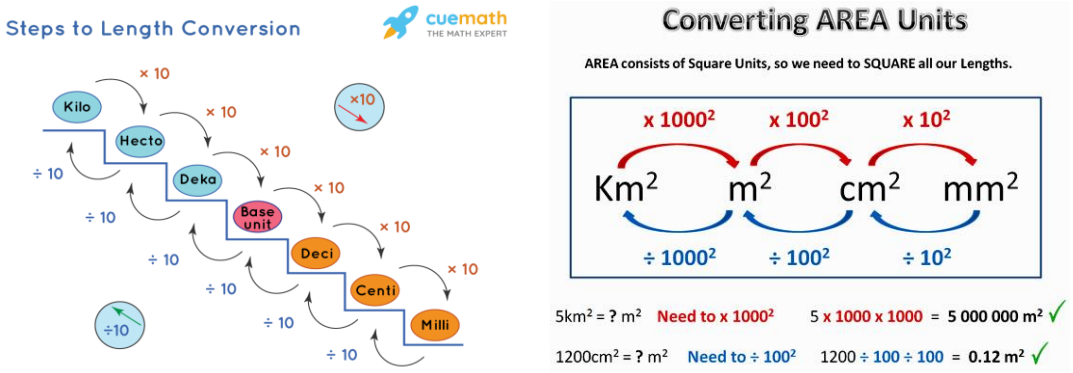
Suggestions for improvement

(a) Teachers must emphasise the factors that affect capacitance and explain thoroughly how each factor affects the capacitance.

(b) Learners must be drilled thoroughly on unit conversion and SI units.

(c) Learners must be exposed to high-order questions and teachers must give timeous feedback on the assessment given. The relationship between current, resistance and power must be explained thoroughly. Teachers must also explain how resistors connected in parallel or series will affect the effective resistance, current and power.

(d) Teachers can make use of the tables below to teach learners unit conversion



Sourced from Pinterest

QUESTION 10: GENERATORS, MOTORS AND TRANSFORMERS

Common errors and misconceptions

(a) In Q10.1 a significant number of candidates had difficulty naming the principle/law that is applicable to a generator and a motor. Some of them confused a *generator* and a *motor* in terms of energy conversion.

(b) Most candidates just wrote 'Faraday's law' instead of the more accurate 'Faraday's law of electromagnetic induction' in Q10.1.1.

(c) In Q10.1.2 a fair number of candidates wrote 'motor' instead of 'motor rule' or 'Fleming's motor rule'.

(d) The majority of candidates struggled to state Lenz law in Q10.2. Some of them lost marks because part marking was not applied in this question and they omitted key words like 'direction' and 'opposes'.

(e) In Q10.3 a significant number of candidates had difficulty converting kV to V. Some lost marks as they omitted the formula from their calculation.

Suggestions for improvement

(a) Teachers must emphasise the laws/principles which are applicable to generators and motors. Energy conversion in the devices must drilled.

(b) Unit conversion and stating laws or principles must be infused in daily teaching and learning.

(c) Learners must be encouraged to copy the formulae directly from the formula sheet and substitute into them without manipulating. They must know that marks are awarded for writing the correct formula, substitution and a correct answer with correct units.

3.5 OVERVIEW OF CANDIDATES' PERFORMANCE IN PAPER 2

General comments

(a) The questions in which performance was below 40% were chemical reactions of organic compounds (Q4) and the electrolytic cell (Q5). The performance of candidates in Q4 has been a challenge in previous years.

(b) The performance was good in Q1 (Multiple-choice Questions) and Q6 (Galvanic cells).

(c) There was an improvement in performance in Q1, Q3, Q5 and Q6. Q3 was based on physical properties of organic molecules, Q5 was on the electrolytic cell and Q6 focused on galvanic cells.

(d) There was a drop in performance in the naming of organic molecules and structures (Q2).

(e) Some candidates did not adhere to the instructions as stipulated in the question paper.

(f) There was an improvement in defining concepts, however, the candidates still left out some of the key words.

(g) Q1.3, which was based on the topic of electronic properties of matter, was problematic for the majority of candidates.

(h) Most of the candidates struggled to use the Table of Standard Reduction Potentials.

(i) Some candidates gave two possible answers as their option in multiple-choice questions or there was overwriting on the letters in such a way that one was unable to see if the answer was A or D.

(j) Direct and inverse proportion relationship was incorrectly used to describe a relationship between physical quantities. Two physical quantities are directly proportional if they both increase/decrease by the same factor, if not then the two quantities are not directly proportional to each other.

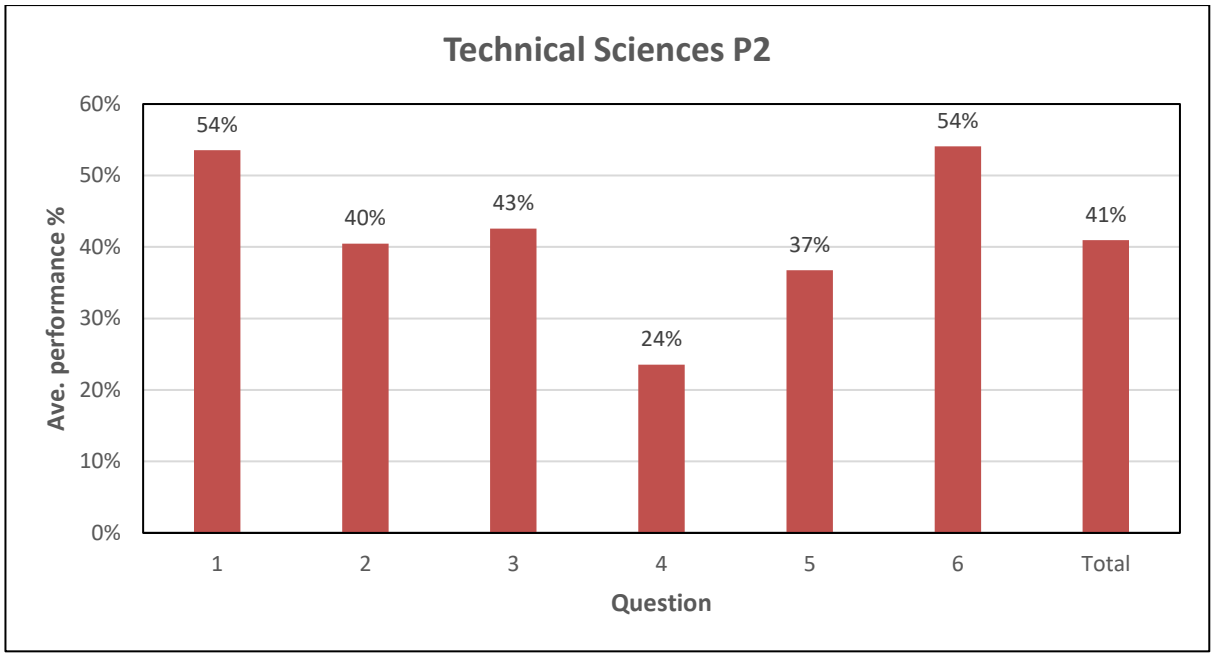
(k) Teachers should infuse experiments into their lessons to help learners to develop scientific enquiry skills that will help them with questions that require scientific explanations. Informal experiments must also be performed.

(l) Teachers should provide opportunities for learners to practise problem-solving skills through a variety of exercises and assessments.

3.6 DIAGNOSTIC QUESTION ANALYSIS OF PAPER 2

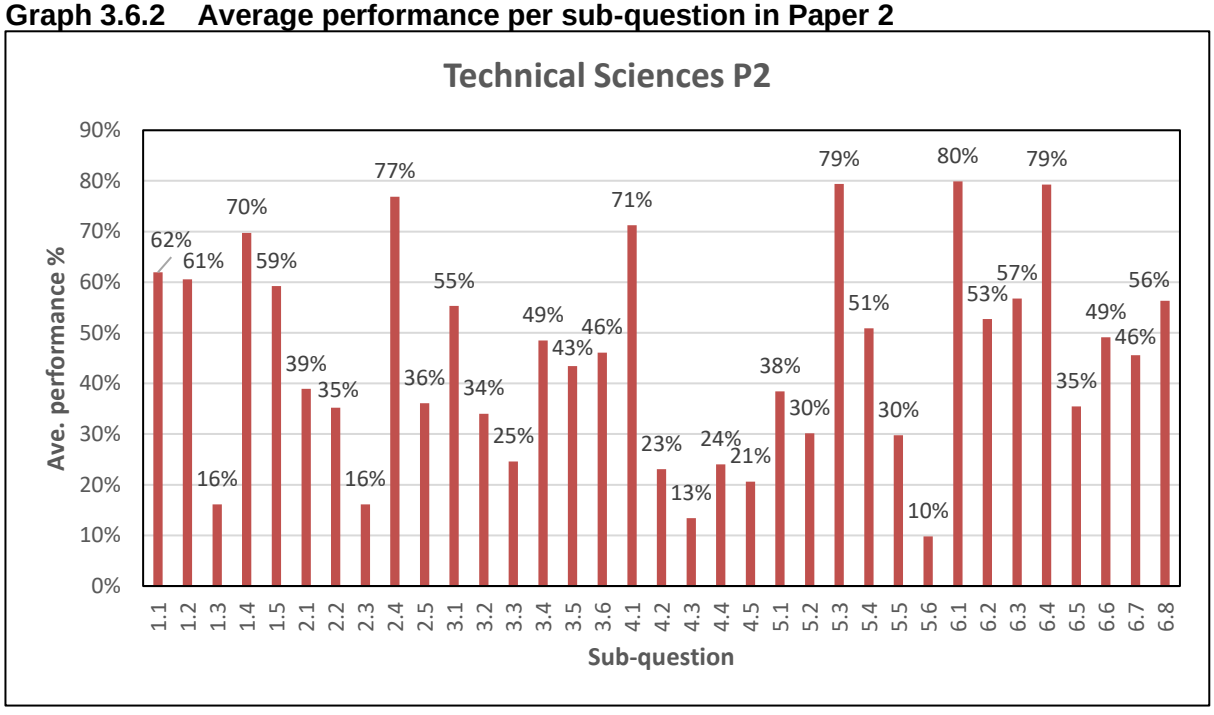
The following graph is based on data from a random sample of candidates. While this graph might not accurately reflect national averages, it is useful to assess the relative degrees of challenge of each question as experienced by candidates.

Graph 3.6.1 Average performance per question in Paper 2



Q	Topics	Q	Topics
1	Multiple-choice Questions	4	Reactions of Organic Compounds
2	Naming of Organic Molecules and Structures	5	Electrolytic Cell
3	Physical Properties of Organic Molecules	6	Galvanic Cell

Graph 3.6.2 Average performance per sub-question in Paper 2



3.7 ANALYSIS OF CANDIDATES' PERFORMANCE IN EACH QUESTION IN PAPER 2

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Common errors and misconceptions

(a) In Q1.2 candidates failed to associate the IUPAC name 2,3-dimethylbutane with the condensed structural formula given.

(b) The majority of the candidates could not choose the correct graph of the current versus applied voltage for the circuit with a diode in Q1.3. They chose the one that describes Ohm's law even though a diode is non-ohmic.

(c) Some candidates confused electrolytic cell with the galvanic cell in Q1.4.

(d) In Q1.5 candidates could not indicate the disadvantages of a photovoltaic cell.

(e) Limited content knowledge and understanding of the basic concepts contributed to incorrect option choices by candidates in the multiple-choice questions.

Suggestions for improvement

(a) The structural formula, condensed structural formula and molecular formula should be used when naming organic compounds.

(b) Teachers must include questions with graphs in the activities given to learners. The difference between *ohmic* and *non-ohmic resistors* should be thoroughly explained with examples. Diagrams, graphs and interactive simulations to illustrate the current-voltage relationships should be utilised. Simple diode-based circuits should be constructed.

(c) Give learners more activities to work with variables rather than numbers. This will give them a chance to relate variables and their proportionality to each other.

(d) Advantages and disadvantages of alternate sources of energy must be emphasised and assessed in informal activities.

(e) Teachers should teach learners the basics of theory and encourage them to work out answers and not just do guess work.

(f) School-based activities like informal tests and class tests must include multiple-choice questions.

(g) Encourage learners to use the method of elimination as part of the steps in getting the correct answer in multiple-choice questions, and encourage them to justify their choices.

(h) Teachers must give constructive feedback timeously.

QUESTION 2: NAMING OF ORGANIC MOLECULES AND STRUCTURAL FORMULAE

Common errors and misconceptions

(a) Candidates could not write the IUPAC name for the given compound in Q2.1.1. The hyphen was omitted or used incorrectly when writing the IUPAC name. The substituent was incorrectly identified.

(b) Candidates were required to give the molecular formula of compound A (alkane) in Q2.1.2 and the general formula of the homologous series of compound A in Q2.1.3

and they could not differentiate between the two. The common error when writing the molecular formula in Q2.1.2 was the incorrect order of elements, e.g. $H_{14}C_6$ and writing the condensed structural formula.

(c) Most of the candidates failed to write down the products formed during combustion of 2-methylpentane which is an alkane given in structural formula in Q2.1.4. The common error made by candidates was identifying only one product instead of two.

(d) In Q2.2.1 most candidates could not identify the homologous series of the given structural formula of compound B which was an aldehyde. They confused the aldehyde with the ketone and the ester.

(e) Most candidates struggled to give the name of the functional group of the aldehyde in Q2.2.2. Most of them wrote 'carbonyl' instead of 'formyl'.

(f) In Q2.3.1 common errors committed by most candidates when drawing structural formula for the functional group of esters were:
- Omitted some of the bonds surrounding the carbon atoms
- Hydrogen atoms were added to the structure
- Drawing the whole structure of the organic compound C instead of its functional group

(g) The majority of the candidates could not identify the carboxylic acid that was used to produce methyl propanoate in Q2.3.2. Some candidates incorrectly named it as 1-propanoic acid or propan-2-oic acid.

(h) Candidates struggled to identify 2-methylpropan-2-ol as a tertiary alcohol. The most common answer was secondary alcohol in Q2.5.

Suggestions for improvement

(a) Teachers should consistently emphasise the importance of adhering to IUPAC nomenclature rules, including the correct use of hyphens and commas. Frequent practice exercises should be incorporated into lessons, focusing on both naming compounds from the given structures and drawing structures from names. Simulations can be used to reinforce the concept of nomenclature and allow learners to practise independently.

(b) The combustion of the alkanes and the products must be thoroughly explained to learners with emphasis on using the molecular formula to write down the chemical reaction. Learners should practise balancing combustion reactions. Teachers should clearly explain that products in any combustion reaction of the alkanes will be CO_2 and H_2O.

(c) The general formula of all the homologous series must be learnt and assessed in school-based activities.

(d) The different functional groups of organic molecules from different homologous series must be thoroughly taught so that it can be easy to identify and draw them. Provide practice exercises that involve identifying functional groups in different molecules.

(e) Teachers must encourage the use of the table with the structures of the functional groups and their names where applicable of the different homologous series.

(f) Naming and formation of the esters must be thoroughly explained.

(g) The difference between primary, secondary and tertiary alcohols must be clearly explained during teaching.

QUESTION 3: PHYSICAL PROPERTIES OF ORGANIC MOLECULES

Common errors and misconceptions

(a) When defining the boiling point in Q3.1, a significant number of candidates left out the following key words: temperature, vapour, pressure and equal. They wrote the word 'point' instead of 'temperature', and used the word 'equilibrium' instead of 'equal'.

(b) In Q3.2 most candidates could not arrange the given molecules in order of decreasing boiling point. Some wrote compounds in increasing order of the boiling point.

(c) In Q3.3 the majority of the candidates struggled to give a relationship between the intermolecular forces and the boiling point. They swopped the dependent and independent variables. The incorrect statement used was that the boiling point and the intermolecular forces are directly proportional to each other.

(d) A notable number of candidates only mentioned London forces and left out dipole-dipole forces in bromoethane. They compared the *energy required* instead of the *strength of the intermolecular forces* as it was required in Q3.5. They used incorrect degrees of comparison such as 'larger' and 'bigger' instead of 'weaker' and 'stronger', 'higher' or 'lower' instead of 'increase' or 'decrease' when referring to the intermolecular forces. They demonstrated a poor understanding of the different strengths of intermolecular forces across various homologous series and were unable to relate intermolecular forces to the physical properties of organic molecules.

(e) A significant number of candidates failed to identify what type of isomers are methyl ethanoate and ethanoic acid in Q3.6.1 and to define it in Q3.6.2.

Suggestions for improvement

(a) Teachers must emphasise the importance of including key words when defining concepts.

(b) The relationship between the strength of the intermolecular forces and the boiling point must be emphasised. This can also be used to arrange compounds in order of increasing or decreasing boiling points.

(c) Teachers must emphasise the importance of mentioning the dominant intermolecular forces of the different compounds when comparing their strength. Strong emphasis must be on comparing 'strength of intermolecular forces' rather than the 'strength of compounds'.

(d) The relationship between physical properties and the impact they have on one another using the strength of intermolecular forces should be explained thoroughly.

(e) When comparing two compounds, learners should mention all the compounds and be specific about the type of intermolecular forces each compound has. The table below can be used as reference:

London forces	Dipole–dipole forces	Hydrogen bonds
• Alkane • Alkene • Alkyne	• Alkyl halides/Haloalkane • Ketones • Aldehydes • Esters	• Alcohol • Carboxylic acids

(f) Learners should be trained on writing the phrase, 'to overcome intermolecular forces' and not 'to break the bonds' when explaining the trends of physical properties.

(g) Relationships between properties with tables and graphs must be taught so learners learn how to interpret different questions.

(h) Teach learners correct terminology such as 'trend' and 'compare' and emphasise what learners must do when certain instructional verbs are used in a question.

(i) Learners must be taught to use the correct adjectives such as 'increase', 'decrease', 'stronger', 'weaker', 'higher', 'lower', 'longer chain' and 'shorter chain' when comparing the strength of the intermolecular forces.

(j) Even though there has been a noticeable decline in the number of candidates using the abbreviation 'IMF', teachers should continually prohibit its use in class.

QUESTION 4: REACTIONS OF ORGANIC COMPOUNDS

Common errors and misconceptions

(a) A significant number of candidates wrote the IUPAC name of the compound instead of the homologous series in Q4.1.

(b) Candidates struggled to draw the structural formula of the haloalkane formed when an alkene reacted with hydrogen bromide and drew the haloalkane with a double bond in Q4.2.1. The common error committed was to omit a bond or hydrogen atom. Others attached bromine in the first carbon instead of the second carbon.

(c) The majority of candidates failed to explain why a compound is classified as a tertiary haloalkane in Q4.2.2. Most candidates said that the halide is bonded to three carbons. They had to refer to the carbon that was bonded to the halide ion/bromide ion and that carbon was bonded to THREE other carbon atoms.

(d) In Q4.2.3 most candidates could not explain why water should not be present when an alkene is converted to haloalkane.

(e) The majority of the candidates could not give the correct reaction conditions when a tertiary haloalkane was converted to an alcohol in Q4.3.1. The common response was 'heat' or 'mild temperature' instead of 'mild heat'.

(f) In Q4.3.2 most candidates used the *structural formula* instead of *molecular formula* to write the chemical equation for the reaction when 2-bromo-2-methylpropane was converted to 2-methylpropan-2-ol. Common errors were:
- The arrow was omitted or an equal sign was used in some instances
- Incorrect molecular formula was used
- The combination of the molecular and structural formula was used

(g) Most candidates struggled to write the name and the type of reaction when the haloalkane was converted to an alcohol in Q4.4.1. They gave either the name or the type of reaction and did not follow instructions.

(h) The majority of the candidates struggled to write down the chemical formula of the inorganic reactant that was used when an alkene was converted to an alcohol in Q4.4.2, and the name of the inorganic reactant needed when an alkene was converted to an alkane in Q4.5.1.

(i) When an alkene was converted to an alkane in Q4.5.2, candidates failed to write the symbol of the catalyst used. They wrote the name instead of the symbol.

Suggestions for improvement

(a) Structural formula of reactants and products in different reactions must be drilled.

(b) The difference between *tertiary*, *secondary* and *primary haloalkanes* and *alcohols* must be thoroughly explained using examples.

(c) The reaction conditions for different reactions must be learnt and teachers must explain why they are necessary.

(d) Molecular formula, structural formula and condensed structural formulae should be used when writing chemical reactions. Learners must be given activities where they need to write balanced chemical equations by using both molecular formulae and structural formulae. Learners must know that these formulae cannot be used interchangeably.

(e) Although Zaitsev's and Markovnikov's rule are not examinable, their applications should be stressed to learners in the very simple organic molecules.

(f) Reactions of organic molecules have to be taught using flow diagrams. Teach the various reactions separately until the various type of organic reactions are clearly understood.

(g) Teachers must emphasise the importance of following the instructions as indicated in the question, for example when the name or symbol is required.

QUESTION 5: ELECTROLYTIC CELL

Common errors and misconceptions

(a) When defining *electrolysis* in Q5.1 most candidates omitted the key words like 'decomposition', 'process' and 'reaction'. When using energy conversion, it was incorrectly stated as 'the process where mechanical energy is converted to electrical energy'. Some of the candidates defined *electrolytic cell* or *electrolyte* instead of *electrolysis*.

(b) The majority of the candidates could not give a reason why the object to be electroplated must be thoroughly cleaned in Q5.2.

(c) Candidates struggled to give the name of the ion in the electrolyte that was used in electroplating in Q5.5. Most candidates wrote Fe^{+} instead of Ag^{+}.

(d) The majority of the candidates confused the half reactions at the two electrodes when the half reaction at the cathode was required in Q5.6. The common errors were:
- Swapped the half reaction at the anode with that of the cathode
- Used double arrows
- Did not to know the symbol for silver
- Did not include the charges on the ions or used wrong charges
- Incorrect half reactions were written. Instead of writing $Ag^+ + e^- \rightarrow Ag$, they wrote $Ag \rightarrow Ag^+ + 2e^-$ or wrote Ag+ as ag+ in the half reaction

Suggestions for improvement

(a) Teachers should ensure that definitions are learnt as they are in the *Examination Guidelines* and with emphasis on the inclusion of the key words.

(b) The experiment should be used to explain what happens during electroplating process. The observations occurring at the anode and the cathode must be discussed with learners.

(c) Teachers should teach learners how to use the Table of Standard Reduction Potentials. They must emphasise that a *single* arrow should be used when writing *half-reactions*, and to ensure that the ions have the correct charges.

(d) The Periodic Table should be taught thoroughly in the lower grades so that learners are familiar with the symbols of the elements as this will enable them to choose the correct half reactions.

(e) Frequent feedback must be given to learners so that content gaps can be closed timeously.

QUESTION 6: GALVANIC CELL

Common errors and misconceptions

(a) Most candidates could not explain why the electrochemical cell was classified as a galvanic cell in Q6.2.

(b) In Q6.5 the majority of the candidates failed to state the functions of the *salt bridge*. Their responses included 'to complete the cell' instead of 'to complete the circuit'. Some stated that 'it allows movement of ions' instead of 'maintain electrical neutrality by allowing movement of ions between the electrolytes'.

(c) Q6.6 was based on a graph indicating how the mass of the electrodes changed when the cell was in operation. A significant number of candidates were not able to choose the graph which indicated how the mass of electrode A (anode) changes.

(d) Some candidates used unconventional formula when calculating the emf of the cell in Q6.8. In some cases, reduction and oxidation E^θ values were swapped around. Candidates also used incorrect E^θ values which was an indication that they did not know the symbols of the elements they were working with. A notable number of candidates were penalised for omitting a superscript or subscript on the formula for calculating E^θ_{cell}. Some wrote the answer with no units.

Suggestions for improvement

(a) Teachers must clearly explain the difference between the *galvanic cell* and the *electrolytic cell*.

(b) Teachers must ensure that the functions of the salt bridge are stated correctly.

(c) The experiment of the galvanic cell must be conducted and the observations on each electrode must be recorded and explained.

(d) Learners should be taught how to make use of the Standard Reduction Potentials Table to get the correct E^{θ} values of the anode and the cathode when calculating the emf of the cell.

(e) The importance of always using the information sheet to copy the formulae correctly can never be overemphasized as marking is very strict when it comes to copying the formulae from the question paper.

CHAPTER 4

CIVIL TECHNOLOGY

Civil Technology encompasses three specialisation subjects, namely Civil Services, Construction and Woodworking. This was the fifth examination in which the specialisation subjects were examined. The following report should be read in conjunction with the respective question papers of the November 2024 NSC examinations.

A detailed analysis of performance trends is provided for each specialisation subject. It must be noted that the following General Comments are observations noted across all three subjects and are therefore stated at the outset.

General comments on Civil Services, Construction and Woodworking:

Certain trends were identified in the 2021, 2022, 2023 and 2024 NSC examinations; however, many of the challenges stated in the 2023 diagnostic report were still evident in the 2024 November NSC examinations.

(a) Although there was a slight improvement in this regard, it was observed that many candidates did not start each question on a new page as requested in the instructions.

(b) A significant number of candidates were not able to interpret and use subject-specific and academic terminology correctly.

(c) It proved to be a challenge to many candidates to respond accurately to the different action verbs used in the question paper (describe, explain, deduce, differentiate, etc.). They were unable to differentiate between the different types of questions.

(d) Most candidates demonstrated poor interpretation and drawing skills. Many candidates could not differentiate between line diagrams, sketches, pictorial views, and scale drawings. Many scale drawings were not done using drawing equipment.

(e) Candidates' knowledge was limited to sketches from previous question papers that were studied verbatim without showing an understanding of the different parts of the drawings. Many candidates displayed an inability to draw sketches that were not tested in previous question papers.

(f) Responses from candidates showed that they lacked practical exposure and experience.

(g) A significant number of candidates failed to label their drawings and, as a result, were not credited with marks.

(h) Many candidates were unable to express themselves accurately when responding to describing and explaining types of questions.

(i) Some candidates did not attempt to answer matching items and multiple-choice questions.

(j) Questions that were structured differently than in previous question papers, posed a challenge to many candidates as they were not able to respond correctly to the new

type of questions. Very poor reading and comprehension skills were evident in the answers provided by many candidates.

(k) Due to a lack of practical experience, many candidates found it difficult to explain practical applications theoretically.

(l) The activities in the textbooks are not sufficient and, in many instances, do not address the expected outcomes of the *CAPS*. Teachers should therefore develop alternative questions that address the expected outcomes, as listed in the *CAPS* for all the topics, to cover all cognitive levels.

(m) Candidates must be aware that they may not be credited for the answer if the relevant unit of measurement is not stated in their answers in calculations.

(n) It is extremely important that candidates adhere to the instructions in the question, e.g. to draw a line diagram OR a drawing showing all details of the object. If candidates respond incorrectly to the instructions, they may lose marks as a result.

(o) Teachers and learners should take note that the assessment criteria in the answer sheets do not indicate all the aspects and mark allocations of the drawings required, as it has an impact on the cognitive demand of the question. The table on the left is an example of details that will appear in the question paper. The table on the right reflects details in the marking guideline. This implies that learners should know all the parts and dimensions of all required drawings.

ASSESSMENT CRITERIA		
NO.	**MARK**	**CANDIDATE'S MARK**
1	2	
2	2	
3	1	
4	1	
5	2	
TOTAL:	**8**	

NO.	ASSESSMENT CRITERIA	MARK
1	Queen post	2
2	Strut	2
3	Connection of parts	1
4	Any ONE label	1
5	Application of scale: All correct = 2 ONE incorrect = 1 TWO and more incorrect = 0	2
	TOTAL:	**8**

4.1 CIVIL SERVICES

The following report should be read in conjunction with the Civil Services question paper of the November 2024 examinations.

4.1.1 PERFORMANCE TRENDS (2020–2024)

The number of candidates who wrote the Civil Services examination in 2024 increased by 29 compared to that of 2023.

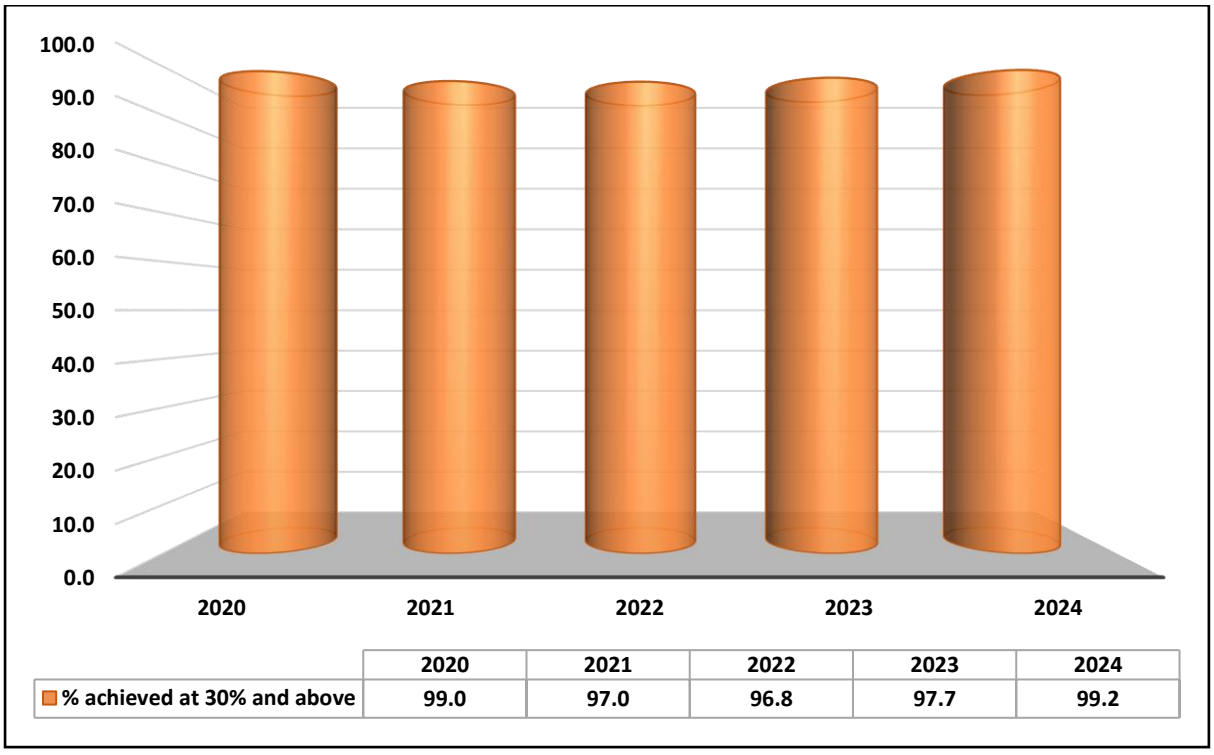
There was a slight improvement in the pass rate this year. Candidates who passed at the 30% level improved from 97,7% in 2023 to 99,2% in 2024. The percentage of distinctions over 80% improved from 1,3% in 2023 to 1,5% in 2024. Given the slight increase in the size of the 2024 cohort, this converts into an increase in the total number of distinctions from 10 to 12.

The various commendable intervention strategies employed by teachers, subject advisors and provincial education departments were continued in 2024. The resourcefulness and diligence of the above-average candidates also contributed to the overall improvement in the subject.

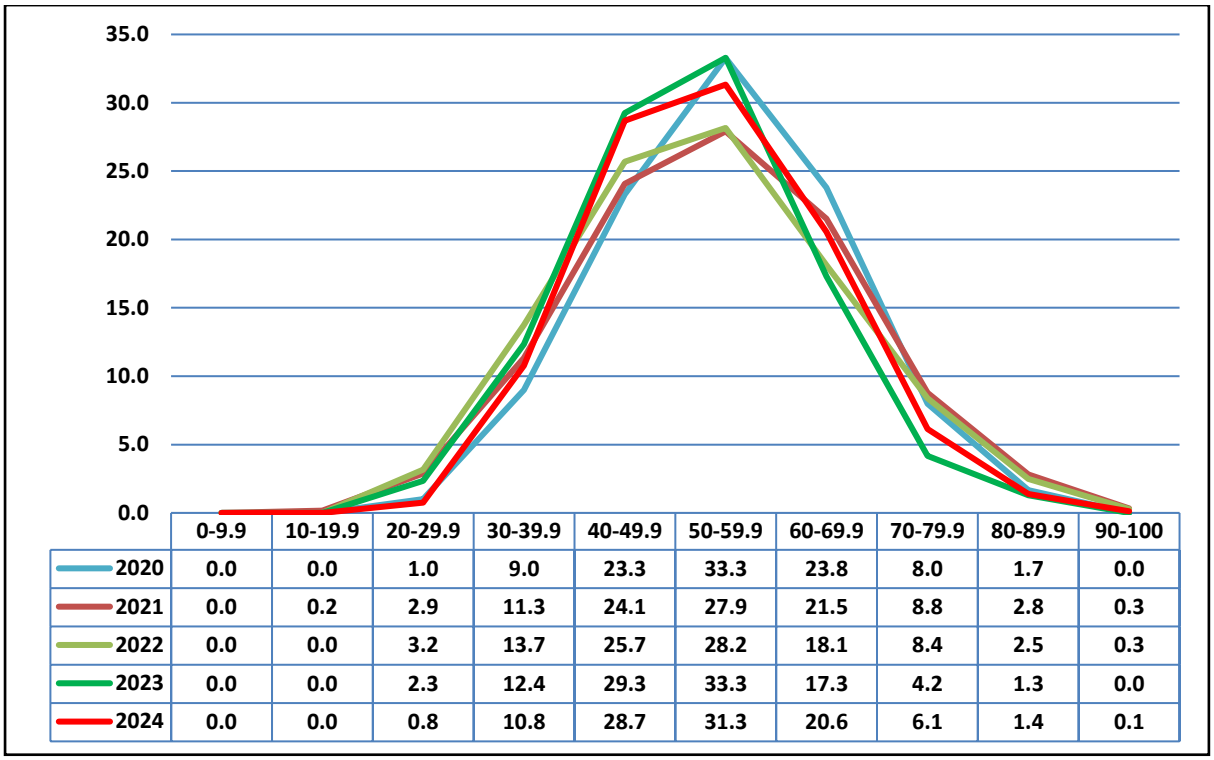
Table 4.1.1 Overall achievement rates in Civil Services

Year	No. wrote	No. achieved at 30% and above	% achieved at 30% and above
2020	601	595	99,0
2021	627	608	97,0
2022	728	705	96,8
2023	769	751	97,7
2024	798	792	99,2

Graph 4.1.1(a) Overall achievement rates in Civil Services (percentage)



Graph 4.1.1(b) Performance distribution curves in Civil Services (percentage)



	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	90-100
2020	0.0	0.0	1.0	9.0	23.3	33.3	23.8	8.0	1.7	0.0
2021	0.0	0.2	2.9	11.3	24.1	27.9	21.5	8.8	2.8	0.3
2022	0.0	0.0	3.2	13.7	25.7	28.2	18.1	8.4	2.5	0.3
2023	0.0	0.0	2.3	12.4	29.3	33.3	17.3	4.2	1.3	0.0
2024	0.0	0.0	0.8	10.8	28.7	31.3	20.6	6.1	1.4	0.1

4.1.2 ANALYSIS OF CANDIDATES' PERFORMANCE IN EACH QUESTION IN CIVIL SERVICES

QUESTION 1: OHSA, MATERIALS, TOOLS, EQUIPMENT AND JOINING

Common errors and misconceptions

(a) In Q1.1 (10 marks) there was a slight improvement in performance in the multiple-choice questions.

(b) In Q1.4 (2 marks) most candidates were not able to explain the effect of cured concrete on the reinforcing and the weight that it can carry. Most candidates responded with general advantages of cured concrete instead of focussing on the specific aspect required.

(c) Q1.5, 1.6 and 1.7 (6 marks) were generally well answered by the majority of the candidates.

Suggestions for improvement

(a) It is recommended that teachers ensure that the generic topics covered in Grades 10, 11 and 12 are still focused on in Grade 12 and not merely revised at the beginning of the year. Teachers should also ensure that these multiple-choice questions are used in formal and informal assessments to ensure that learners are familiar with these types of questions.

(b) Learners must be taught to first read the question carefully. Learners should then isolate the exact aspect within the topic that would form the basis of their response. It will be beneficial to learners if they are exposed to the answering of questions that are based on real-life situations.

(c) Practical demonstrations and exercises using the tools and equipment as dealt with in this section will improve the understanding of the use and care of these instruments among learners and enable them to explain in their own words how to use these tools for a specific purpose.

QUESTION 2: GRAPHICS AS A METHOD OF COMMUNICATION

Common errors and misconceptions

(a) In Q2.1 (1 mark) very few candidates were able to indicate the measurement of the dwelling correctly. Most candidates confused the measurements of the dwelling with those of the site and provided incorrect answers as a result. Many candidates did not include the unit in the answer and were not credited as a result.

(b) A surprising number of candidates were not able to identify the symbol of a hot-water cylinder in Q2.15 (1 mark).

(c) In Q2.20 some candidates experienced difficulties to explain why it would be difficult to enter the dwelling at number 8 and were not able to phrase a proper response explaining that the height between the NGL and the FFL would be too high.

(d) In Q2.24 (5 marks) the drawing of the symbol for a sink unit (double) was well answered by most candidates, but many candidates positioned the outlets of the sink incorrectly, drawing the two bowls separated by a rib (which is not in line with the *SANS* symbol) and they lost marks as a result.

(e) Q2.26 (6 marks) was well-answered by most candidates. There was a significant improvement in the ability of candidates to answer this type of question, but many candidates did not subtract the dimension of the opening of the entrance to determine the total length of the fencing required and lost marks as a result.

(f) Q2.27 (3 marks) was challenging for some candidates. This was the first time that candidates were expected to manipulate a formula to calculate the length of the side as required. Despite this being a new type of question, a surprising number of candidates were able to answer this question.

Suggestions for improvement

(a) The use of correct terminology in terms of the different aspects on a building plan is of the utmost importance when teaching this topic. Teachers need to ensure that learners understand the difference between similar aspects of this topic and can distinguish between them.

(b) It will be beneficial to learners if teachers require them to draw the symbols used on building plans, write the abbreviations and names of these symbols during class and homework activities and give short informal assessments on this topic on a regular basis.

(c) More emphasis should be placed on the development of the skills required to describe and explain concepts in a logical manner.

(d) More analytical questions and worksheets, like those in Q2, should be used in class, focusing on the correct terminology for each part of the drawings as well as the drawing and interpretation of the different symbols.

(e) It will be beneficial to learners if they are exposed to more calculations involving the manipulation of a formula, area, perimeter, and lengths of walls to ensure that they are equipped to respond to these types of questions accurately.

QUESTION 3: CONSTRUCTION ASSOCIATED WITH CIVIL SERVICES, OHSA AND QUANTITIES

Common errors and misconceptions

(a) Q3.1 (5 marks) was well-answered by most candidates.

(b) Q3.2 (3 marks) was poorly answered by most candidates. Many candidates were not able to name the required equipment using the correct subject terminology in Q3.2.2 and Q3.2.3.

(c) In Q3.3 (8 marks) many candidates could not differentiate between a horizontal and a vertical sectional view of the manhole and drew the vertical section instead of the horizontal section as required. By drawing the incorrect sectional view candidates lost several marks.

(d) There was a slight improvement in performance in Q3.4 which dealt with the calculation of quantities, but this topic still poses a challenge to many candidates.

(e) Q3.5 was poorly answered by most candidates, and it was evident that candidates did not possess the required skill and knowledge to interpret the drawing and to draw the consecutive brick course to form the correct bond.

Suggestions for improvement

(a) It is recommended that questions of this nature should be asked in formal and informal assessments to familiarise the learners with the vocabulary being used, enabling learners to respond to these questions accurately.

(b) It is advised that during the teaching of each topic, teachers give a list of terminologies and the meaning thereof to learners to write in their workbooks. These terminologies should also be tested in informal assessments regularly.

(c) Teachers should encourage learners to read the questions carefully and to carefully consider the instructions before attempting to answer the question.

(d) Learners may benefit from practical exercises where they can be exposed to the calculation of the quantities of materials from real-life situations. This may lead to a better understanding of the interpretation of working drawings if they are used in conjunction with a real representation of what is displayed on the drawings.

(e) Practical activities like the dry packing of the different brick walls using the prescribed bonds and the drawing of the actual bonds from the dry packed courses would assist learners in the development of the required knowledge and skills to draw these courses correctly.

QUESTION 4: COLD AND HOT-WATER SUPPLY, TOOLS, EQUIPMENT AND MATERIALS

Common errors and misconceptions

(a) In Q4.1 (4 marks), many candidates were not equipped to differentiate between the internal and external devices that open and close the different valves.

(b) In Q4.2.1 (1 mark) a significant number of candidates were not able to identify the pipe thread-cutting machine by stating the correct name.

(c) In Q4.3 (3 marks) most candidates found it difficult to identify the fault and to explain how an airlock can be prevented in a water system. Many candidates described the drawing in Figure 4.3 instead.

(d) The drawing of the hot-water *SANS* symbols in Q4.5 (6 marks) was answered very poorly by most of the candidates. Many candidates did not attempt to draw the symbols for the pressure switch and the expansion-control valve.

(e) In Q4.6 (7 marks) many candidates had difficulty to identify the components of a high-pressure geyser installation and explaining the function of each component.

(f) In Q4.8 (3 marks) most candidates found it challenging to name the reactions that take place in the processes as described in the question.

Suggestions for improvement

(a) It is recommended that more emphasis be placed on the disassembly, reassembly and installation of the different valves during practical sessions so that learners can physically see the different components and understand the function of each part.

(b) The correct subject terminology should be used during teaching, and teachers should avoid using layman's terms when teaching.

(c) The learners will benefit from having more practical experience in the identifying and fixing of faults in pipe systems. Performing these fault-finding tests and doing the repairs during practical sessions will enable the learners to respond better in writing, having a better frame of reference.

(d) It is advised that drawing and identification of symbols should be tested on a regular basis, as they play an integral part in the teaching of this subject. Learners should be encouraged to read the questions more than once to ensure that the response meets the expectations of the question.

(e) It will be beneficial to learners if teachers explain the installation of the high-pressure geyser and any similar installations by means of a practical demonstration so that learners can clearly see and understand where each component is installed and what the function of each component is.

(f) The chemical reactions and processes that take place in plumbing installations is a very abstract topic which most learners find very challenging to understand and to respond to. It is recommended that teachers develop a table showing the different chemical reactions, the names of the reactions and how they can be prevented to assist learners when they study this section.

QUESTION 5: GRAPHICS AS MEANS OF COMMUNICATION, ROOF WORK AND STORM WATER

Common errors and misconceptions

(a) In Q5.1 (6 marks) many candidates were not able to respond well to the development of the stopped end of a gutter.

(b) Many candidates found it challenging to answer questions that expected them to draw a pictorial view of an object in Q5.3 (4 marks) where a pre-cast concrete channel had to be drawn.

(c) Poor performance was displayed in the drawing of the development of a square-based truncated pyramid in Q5.4 (19 marks). Many candidates were not able to apply the basic drawing principles for developments or did not attempt the question at all. It was also evident that many candidates did not use drawing equipment correctly.

Suggestions for improvement

(a) It will benefit learners if they are allowed to draw and make a stop end of a gutter in the workshop during practical periods so that they can be exposed to this topic in a real-life situation.

(b) It is recommended that teachers give learners different objects, starting with simple examples, to draw using pictorial views from Grade 10 to develop these drawing skills over a period of three years.

QUESTION 6: SEWERAGE, SANITARY FITTINGS AND JOINING

Common errors and misconceptions

(a) In Q6.2 (5 marks), many candidates were not able to identify the type of urinal using the correct subject terminology and lost marks as a result. A significant number of candidates experienced challenges in identifying, explaining and describing the function of the flush valve.

(b) Q6.3 (5 marks) was not well answered by many candidates. The candidates were unable to identify the soldering iron correctly and had difficulty in explaining the composition of the soldering stick and the purpose of coating the joint with flux prior to soldering.

(c) In Q6.5 (10 marks) very poor performance was recorded. Many candidates were not equipped to complete the drawing of the vertical sectional view of a septic tank. It was evident that many candidates lacked the content knowledge of the composition and working principles of a septic tank.

(d) In Q6.6 (11 marks) the design and drawing of the drainage plan was challenging to many candidates. Candidates demonstrated an inability to use the correct line type for the sewerage pipes, were not able to position the branch pipes and other components correctly and were not able to draw the connection of the two main sewer pipes at an angle of 45° with the correct direction of flow.

Suggestions for improvement

(a) The use of pictures and video clips of real examples of the different types of urinals and flush valves can contribute to a better understanding among learners of the different types of urinals used in the industry. Many learners find it very challenging to relate properly to concepts as seen from two-dimensional representations.

(b) A possible reason for the poor performance in this question may be the lack of practical exposure to soldering. It will be beneficial to learners if they can be exposed to practical exercises using soldering irons, with and without flux so that they can experience first-hand the effect that the flux has on the soldering process.

(c) It is recommended that teachers make scale models of a septic tank and a French drain as well as a conservancy tank that can be used as a teaching aid when this topic is taught. It will be beneficial to learners if they can physically see how the system operates during the teaching of this topic. Learners should also be allowed to explain the composition and working principles of the different systems to the class while the teacher uses the language of teaching and learning.

(d) It will benefit learners if teachers organise site visits where these drainage systems are being installed and can be viewed. Alternatively, the teacher can take the learners on a tour around the school starting with a manhole at the highest point and working their way down to the lowest point. Along the way, different sewerage components like rodding eyes, gullies, ventilation pipes and junctions can be shown to learners to enhance their understanding of all these components before they are exposed to the two-dimensional drawing of sewerage plans.

4.2 CONSTRUCTION

The following report should be read in conjunction with the Construction question paper of the November 2024 Examinations.

4.2.1 PERFORMANCE TRENDS (2020–2024)

The number of candidates who sat for the Construction examination in 2024 increased by 184, compared to that of 2023.

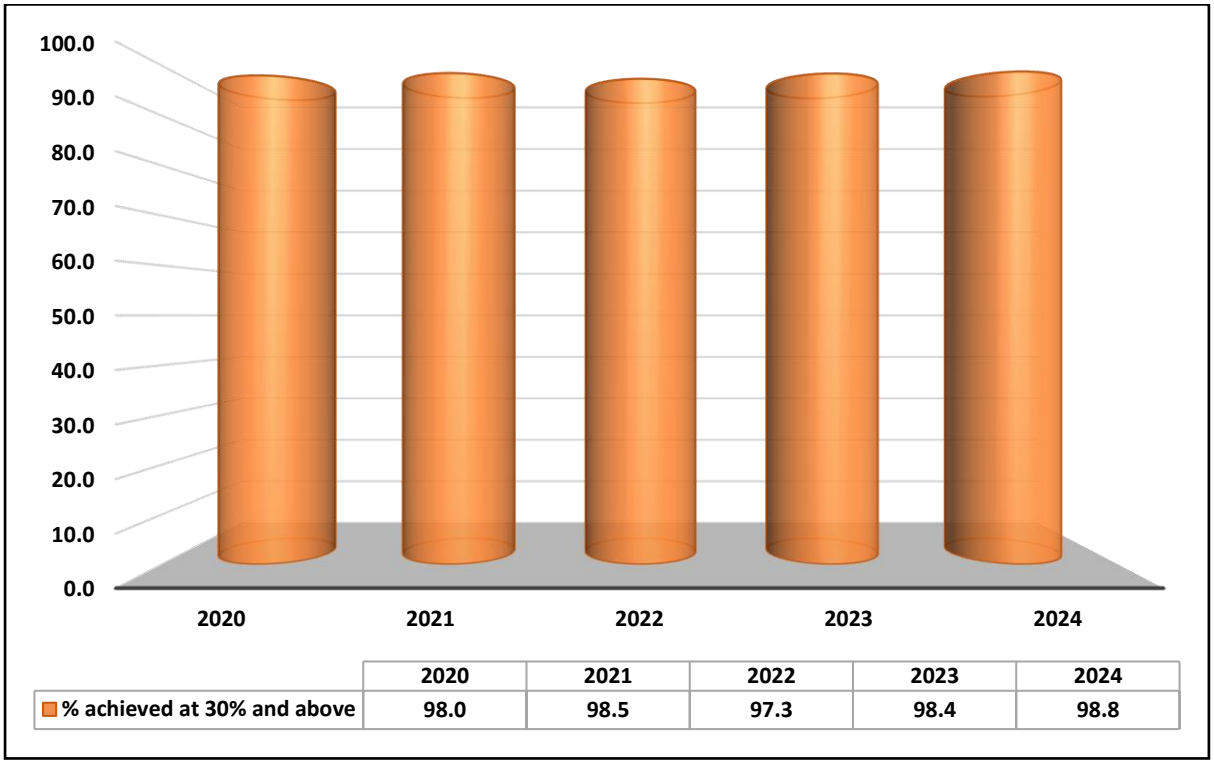
There was a slight improvement in the pass rate this year. Candidates who passed at the 30% level improved from 98,4% in 2023 to 98,8% in 2024. The percentage of distinctions over 80% improved from 1,5% in 2023 to 2,1% in 2024. Given the slight increase in the size of the 2024 cohort, this converts into an increase in the total number of distinctions from 66 to 96.

The various commendable intervention strategies employed by teachers, subject advisors and provincial education departments were continued in 2024. The resourcefulness and diligence of the above-average candidates also contributed to the overall improvement in the subject.

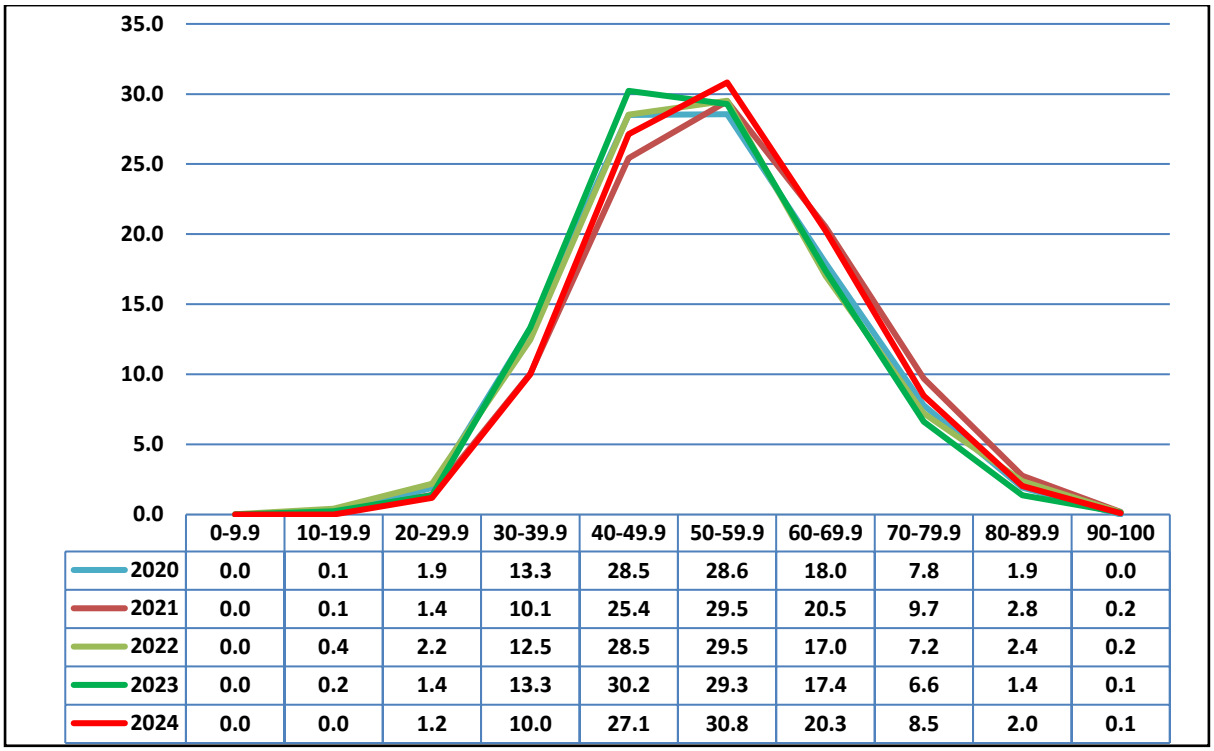
Table 4.2.1 Overall achievement rates in Construction

Year	No. wrote	No. achieved at 30% and above	% achieved at 30% and above
2020	3 582	3 511	98,0
2021	4 474	4 406	98,5
2022	4 773	4 646	97,3
2023	4 387	4 317	98,4
2024	4 571	4 516	98,8

Graph 4.2.1(a) Overall achievement rates in Construction (percentage)



Graph 4.2.1(b) Performance distribution curves in Construction (percentage)



	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	90-100
2020	0.0	0.1	1.9	13.3	28.5	28.6	18.0	7.8	1.9	0.0
2021	0.0	0.1	1.4	10.1	25.4	29.5	20.5	9.7	2.8	0.2
2022	0.0	0.4	2.2	12.5	28.5	29.5	17.0	7.2	2.4	0.2
2023	0.0	0.2	1.4	13.3	30.2	29.3	17.4	6.6	1.4	0.1
2024	0.0	0.0	1.2	10.0	27.1	30.8	20.3	8.5	2.0	0.1

4.2.2 ANALYSIS OF CANDIDATES' PERFORMANCE IN EACH QUESTION IN CONSTRUCTION

QUESTION 1: OHSA, MATERIALS, TOOLS, EQUIPMENT AND JOINING

Common errors and misconceptions

(a) In Q1.1 (10 marks) there was a slight improvement in performance in the multiple-choice questions.

(b) In Q1.4 (2 marks) most candidates were not able to explain the effect of cured concrete on the reinforcing and the weight that it can carry. Most candidates responded with general advantages of cured concrete instead of focussing on the specific aspect required.

(c) Q1.5, 1.6 and 1.7 (6 marks) were generally well answered by the majority of candidates.

Suggestions for improvement

(a) It is recommended that teachers ensure that the generic topics covered in Grades 10, 11 and 12 are still focused on in Grade 12 and not merely revised at the beginning of the year. Teachers should also ensure that these multiple-choice questions are used in formal and informal assessments to ensure that learners are familiar with these types of questions.

(b) Learners must be taught to first read the question carefully. Learners should then isolate the exact aspect within the topic that would form the basis of their response. It

will be beneficial to learners if they are exposed to the answering of questions that are based on real-life situations.

(c) Practical demonstrations and exercises using the tools and equipment as dealt with in this section will improve the understanding of the use and care of these instruments among learners and enable them to explain in their own words how to use these tools for a specific purpose.

QUESTION 2: GRAPHICS AS METHOD OF COMMUNICATION

Common errors and misconceptions

(a) In Q2.1 (1 mark) very few candidates were able to indicate the measurement of the dwelling correctly. Most candidates confused the measurements of the dwelling with those of the site and provided the incorrect answer as a result. Many candidates did not include the unit in the answer and were not credited as a result.

(b) A surprising number of candidates were not able to identify the symbol of a hot-water cylinder in Q2.15 (1 mark).

(c) In Q2.20 some candidates experienced difficulties with explaining why it would be difficult to enter the dwelling at number 8 and were not able to phrase a proper response explaining that the height between the NGL and the FFL would be too high.

(d) In Q2.24 (5 marks) the drawing of the symbol for a sink unit (double) was well answered by most candidates, but many candidates positioned the outlets of the sink incorrectly, drawing the two bowls separated by a rib (which is not in line with the SANS symbol) and lost marks as a result.

(e) Q2.26 (6 marks) was well answered by most candidates. There was a significant improvement in the ability of candidates to answer this type of question, but many candidates did not subtract the dimension of the opening of the entrance to determine the total length of the fencing required and lost marks as a result.

(f) Q2.27 (3 marks) was challenging for some candidates. This was the first time that candidates were expected to manipulate a formula to calculate the length of the side as required. Despite this being a new type of question, a surprising number of candidates were able to answer this question.

Suggestions for improvement

(a) The use of correct terminology in terms of the different aspects on a building plan is of the utmost importance when teaching this topic. Teachers need to ensure that learners understand the difference between similar aspects of this topic and can distinguish between them.

(b) It will be beneficial to learners if teachers require of them to draw the symbols used on building plans, write the abbreviations and names of these symbols during class and homework activities and give short informal assessments on this topic on a regular basis.

(c) More emphasis should be placed on the development of the skills required to describe and explain concepts in a logical manner.

(d) More analytical questions and worksheets, like those in Q2, should be used in class, focusing on the correct terminology for each part of the drawings as well as the drawing and interpretation of the different symbols.

(e) It will be beneficial to learners if they are exposed to more calculations involving the manipulation of a formula, area, perimeter, and lengths of walls to ensure that they are equipped to respond to these types of questions accurately.

QUESTION 3: ROOFS, STAIRCASES AND JOINING

Common errors and misconceptions

(a) Q3.1.1–3.1.3 (4 marks) reflected a poor performance by the candidates. Candidates found it challenging to describe the terminologies (pitch line, balustrade and run) based on staircases.

(b) Q3.3 (1 mark) proved to be challenging for most candidates. Candidates could not respond accurately when asked to identify the maximum distance between the rafters when concrete roof tiles are used.

(c) In Q3.4 (1 mark) candidates could not identify the type of roof covering to use when the spacing between the roof trusses was given.

(d) Most candidates were not able to draw the connection of the rafter, queen post and strut and apply the prescribed scale in Q3.5 (8 marks).

(e) In Q3.6 (14 marks) many candidates were unable to draw the components of a king post roof truss to scale. Candidates could not apply the prescribed scale.

Suggestions for improvement

(a) It is recommended that teachers use wall charts and scale models of the different types of staircases, indicating the different parts with the correct terminology during teaching. This will enable the learners to respond more accurately to questions that expect them to describe the different parts of a staircase.

(b) The understanding of the concept of the spacing of roof trusses to carry different types of roof coverings can be improved by using scale models of roof trusses covered with different roof coverings, with the dimensions of the spacing between the roof trusses clearly indicated.

(c) It is recommended that simulation tasks should be done during practical lessons that require the learners to build models showing the differences between trusses and the truss members.

(d) It will be beneficial to learners if teachers provide them with more exercises on the drawing of scale drawings focussing on the application of different scales and the correct use of drawing equipment.

QUESTION 4: EXCAVATIONS, FORMWORK, TOOLS AND EQUIPMENT AND MATERIALS

Common errors and misconceptions

(a) In Q4.1 (5 marks), the majority of the candidates were not able to match the word with

its description from the provided list.

(b) In Q4.2 (5 marks) a significant number of candidates performed poorly in the multiple-choice questions on excavations.

(c) In Q4.4 (8 marks) most candidates could not draw the vertical sectional view of the shuttering for firm soil correctly. Many candidates failed to print two labels as required which resulted in a loss of marks.

(d) In Q4.7 (8 marks) many candidates displayed difficulty in recalling the content knowledge applicable to the cube test (purpose, apparatus and procedures).

(e) In Q4.8 (10 marks) a significant number of candidates were not able to identify the components of formwork from the provided list.

Suggestions for Improvement

(a) It is recommended that teachers spend more time and initiate more activities for learners to develop critical thinking, reading, and, especially, comprehension skills in all topics that lend themselves to these kinds of questions.

(b) It will be beneficial to the learners if excavations can be dug, and shuttering can be placed in the excavation during practical lessons. This will expand the learners' knowledge and will enable them to apply this knowledge during assessments.

(c) It is recommended that teachers provide learners with more exercises on the drawing and interpretation of the sectional views of the vertical sectional view of the shuttering for firm soil.

(d) Using equipment during practical lessons is a very important exercise for the learners to acquire basic skills. If the equipment is not available, videos can be played during lessons. The topics on the cube test and slump test should not be neglected in Grade 12 because they were covered in Grades 10 and 11. Revision of these topics can be done before formal assessments to refresh the learners' knowledge of these topics.

(e) A possible reason for the very poor performance in this question might be that learners were not exposed to these types of questions where a label must be matched with words from a list. It is of the utmost importance that teachers do not only rely on the activities in the textbook, but that they develop additional questions on each topic to address the expected outcomes in the CAPS accurately.

QUESTION 5: PLASTER AND SCREED, BRICKWORK AND GRAPHICS AS MEANS OF COMMUNICATION

Common errors and misconceptions

(a) In Q5.1 (3 marks) many candidates had difficulty in responding accurately to the questions based on the splatter finish of a wall.

(b) Responses from most candidates indicated that they found it difficult to describe the purpose of skimming of plaster in Q5.2.1 (1 mark).

(c) In Q5.3 (1 mark) several candidates were not able to define the term 'dry screed' accurately.

(d) In Q5.5 (2 marks) a significant number of candidates found it challenging to explain the advantages of beam filling accurately.

(e) In Q5.6 (4 marks) numerous candidates were unable to distinguish between the shape of the bricks and mortar joints of gauged arches.

(f) The majority of the candidates had difficulty in completing the drawing of the construction of paving blocks with a restrained edge in Q5.7 (8 marks). Many candidates also neglected to indicate the symbol for concrete in the drawing.

(g) Q5.8 (9 marks) required the candidates to complete the first and second courses of a one-and-a-half brick pier attached to a one-brick wall in English bond. Many candidates were not able to complete the drawing of the brick pier on each course.

Suggestions for improvement

(a) It is recommended that all the tools that are prescribed in the *CAPS* should be available for learners to use and that the plastering process and the different types of finishes should be practised by learners during practical sessions.

(b) It will be beneficial if practical examples of the different types of plaster and screed processes are used during teaching. It is also advised that learners be given the opportunity to apply these processes during practical sessions. This will enable learners to understand the principles and application of these types of processes.

(c) More attention should be given to the content recall and comprehension skills of learners to enable them to critically interpret, evaluate and logically differentiate between different aspects and processes. This should better equip learners to respond to the various types of questions that are found throughout the question paper.

(c) It is recommended that teachers provide learners with more exercises on the drawings and interpretation of the drawings of different paving methods.

(d) A possible reason for the poor performance in Q5.8 may be that learners were not exposed to the sectional views of the first and second courses of a one-and-a-half brick pier attached to a one-brick wall in English bond focussing on the different courses, and differences between the layers. It is of utmost importance that teachers do not only rely on the activities in the textbook but that they develop additional questions on each topic to accurately address the expected outcomes in the CAPS.

QUESTION 6: REINFORCEMENT IN CONCRETE, FOUNDATIONS, CONCRETE FLOOR AND QUANTITIES

Common errors and misconceptions

(a) In Q6.1 (5 marks) many candidates displayed an inability to select the correct description in column B to match the items listed in column A.

(b) It was evident that most candidates found it difficult to respond accurately to Q6.2 (7 marks) which involved questions regarding the reinforcement of concrete beams.

(c) Most candidates were not able to sketch, in good proportion, a steel tube caisson pile that is driven into the ground in Q6.3.1 correctly (7 marks). Some candidates were able to draw the steel pipe casing but were not able to draw the details (steel cable, drop hammer and concrete plug) inside the pipe.

(d) In Q6.3.2 (2 marks) many candidates were not able to explain two circumstances that do not require the use of piles. Many candidates explained the circumstances that do require the use of piles.

(e) In Q6.4.2 (2 marks) it was evident from the responses of many candidates that they were unable to state the safety measures to consider after installing a rib and block floor.

(f) In Q6.5 (16 marks) it was evident that the calculation of the area of the walls, area of the door and number of bricks needed to build the superstructure of the building was very challenging for many candidates. The candidates demonstrated a lack of knowledge of the correct use of the dimension paper. Many candidates did not use the information that was given and tried to calculate the centre line, which was not a requirement.

Suggestions for improvement

(a) A possible reason for the inability of the learners to select the correct description may be the lack of exposure to these concepts during teaching and assessment. It is recommended that teachers provide learners with more exercises, including similar types of questions in order for learners to perform better.

(b) Learners will benefit greatly from being taught different aspects related to reinforcement in concrete, and teachers should break it down into smaller sections so that learners can understand the use of each part (types of beams, reinforcement of beams, advantages and disadvantages of reinforced concrete beams and purpose of spacers), its position in the process and the reason for each part. This will have a greater impact than teaching each section in isolation and relying on rote learning for learners to recall information.

(c) The poor performance in this question may result from a lack of understanding of the different types of concrete piles and the installation processes of each. It is recommended that learners are taught to understand each process and the drawing of each. Learners should be discouraged from memorising without understanding. Instead, the focus should be on equipping learners with the skills to break down and logically reassemble processes and drawings. This will assist learners to recall and represent the required detail when asked to do so during assessments.

(d) Teachers should emphasise the different types of action verbs that can be used in questions and ensure that learners understand how to respond to different types of questions. Learners should be encouraged to read questions carefully before responding to them, to ensure that they are responding accurately to the question.

(e) Learners should be exposed to more exercises on the calculation of quantities of materials for a building to develop a better understanding of the topic. These calculations should always be done on dimension paper so that learners become familiar with this process of the correct use of the dimension paper in preparation for examinations.

4.3 WOODWORKING

The following report should be read in conjunction with the Woodworking question paper of the November 2024 examinations.

4.3.1 PERFORMANCE TRENDS (2020–2024)

The number of candidates who sat for the Woodworking examinations in 2024 increased by 97, compared to that of 2023.

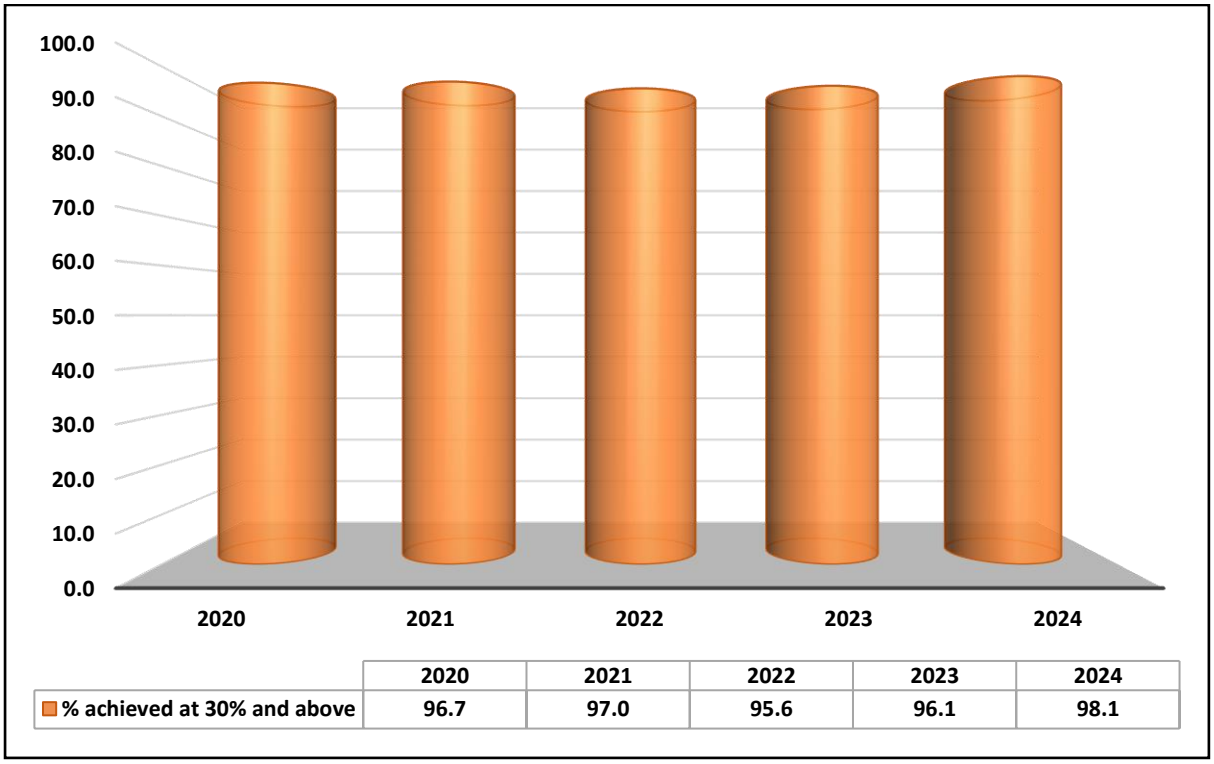
There was a slight improvement in the pass rate this year. Candidates who passed at the 30% level improved from 96,1% in 2023 to 98,1% in 2024. The percentage of distinctions over 80% remained consistent for the past two years, at 1,5%. Given the slight increase in the size of the 2024 cohort, this converts into an increase in the total number of distinctions from 33 to 35.

The various commendable intervention strategies employed by teachers, subject advisors and provincial education departments were continued in 2024. The resourcefulness and diligence of the above-average candidates also contributed to the overall improvement in the subject.

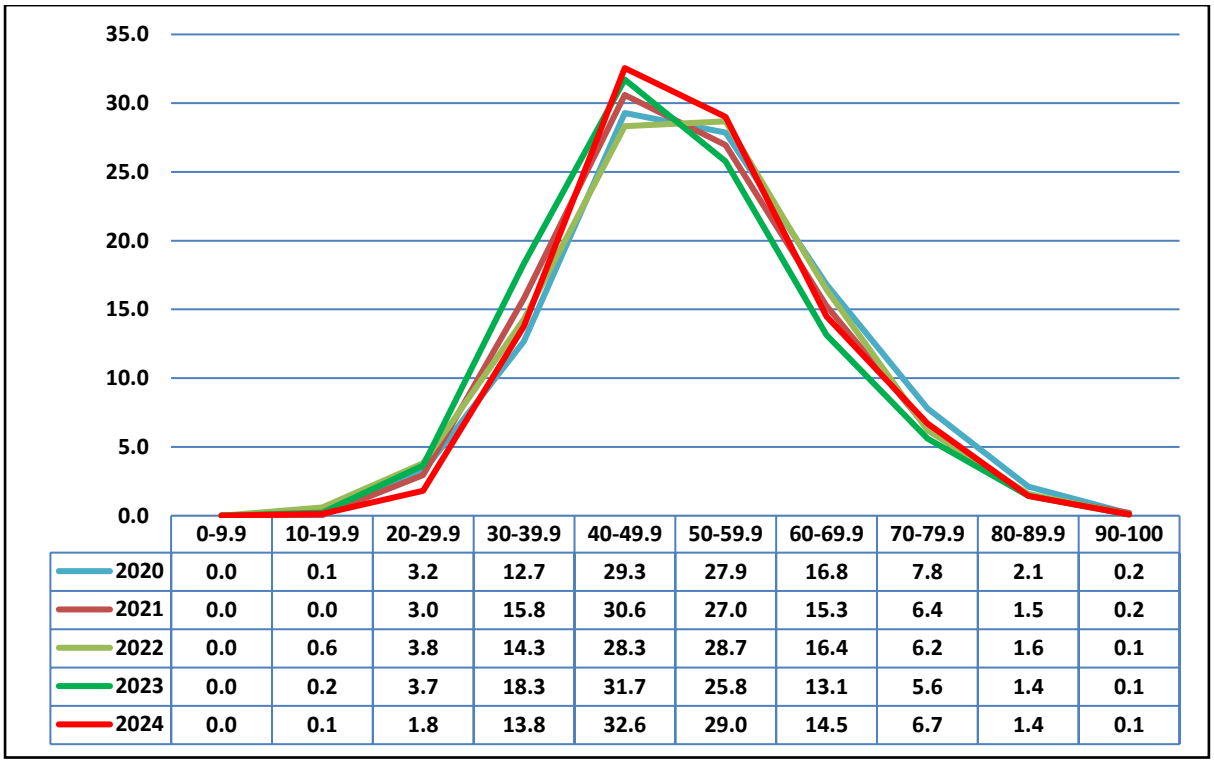
Table 4.3.1 Overall Achievement Rates in Woodworking

Year	No. wrote	No. achieved at 30% and above	% achieved at 30% and above
2020	1 837	1 777	96,7
2021	2 366	2 294	97,0
2022	2 542	2 430	95,6
2023	2 213	2 127	96,1
2024	2 310	2 265	98,1

Graph 4.3.1(a) Overall achievement rates in Woodworking (percentage)



Graph 4.3.1 (b) Performance distribution curves in Woodworking (percentage)



	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	90-100
2020	0.0	0.1	3.2	12.7	29.3	27.9	16.8	7.8	2.1	0.2
2021	0.0	0.0	3.0	15.8	30.6	27.0	15.3	6.4	1.5	0.2
2022	0.0	0.6	3.8	14.3	28.3	28.7	16.4	6.2	1.6	0.1
2023	0.0	0.2	3.7	18.3	31.7	25.8	13.1	5.6	1.4	0.1
2024	0.0	0.1	1.8	13.8	32.6	29.0	14.5	6.7	1.4	0.1

4.3.2 ANALYSIS OF CANDIDATES' PERFORMANCE IN EACH QUESTION IN WOODWORKING

QUESTION 1: OHSA, MATERIALS, TOOLS, EQUIPMENT AND JOINING

Common errors and misconceptions

(a) In Q1.1 (10 marks) there was a slight improvement in performance in the multiple-choice questions.

(b) In Q1.4 (2 marks) most candidates were not able to explain the effect of cured concrete on the reinforcing and the weight that it can carry. Most candidates responded with general advantages of cured concrete instead of focussing on the specific aspect required.

(c) Q1.5, 1.6 and 1.7 (6 marks) were generally well answered by the majority of candidates.

Suggestions for improvement

(a) It is recommended that teachers ensure that the generic topics covered in Grades 10, 11 and 12 are still focused on in Grade 12 and not merely revised at the beginning of the year. Teachers should also ensure that these multiple-choice questions are used in formal and informal assessments to ensure that learners are familiar with these types of questions.

(b) Learners must be taught to first read the question carefully. Learners should then isolate the exact aspect within the topic that would form the basis of their response. It will be beneficial to learners if they are exposed to the answering of questions that are based on real-life situations.

(c) Practical demonstrations and exercises using the tools and equipment as dealt with in this section will improve the understanding of the use and care of these instruments among learners and enable them to explain in their own words how to use these tools for a specific purpose.

QUESTION 2: GRAPHICS AS METHOD OF COMMUNICATION

Common errors and misconceptions

(a) In Q2.1 (1 mark) very few candidates were able to indicate the measurement of the dwelling correctly. Most candidates confused the measurements of the dwelling with those of the site and provided the incorrect answer as a result. Many candidates did not include the unit in the answer and were not credited as a result.

(b) A surprising number of candidates were not able to identify the symbol of a hot-water cylinder in Q2.15 (1 mark).

(c) In Q2.20 some candidates experienced difficulties with explaining why it would be difficult to enter the dwelling at number 8 and were not able to phrase a proper response explaining that the height between the NGL and the FFL would be too high.

(d) In Q2.24 (5 marks) the drawing of the symbol for a sink unit (double) was well answered by most candidates, but many candidates positioned the outlets of the sink incorrectly, drawing the two bowls separated by a rib (which is not in line with the SANS symbol) and lost marks as a result.

(e) Q2.26 (6 marks) was well answered by most candidates. There was a significant improvement in the ability of candidates to answer this type of question, but many candidates did not subtract the dimension of the opening of the entrance to determine the total length of the fencing required and lost marks as a result.

(f) Q2.27 (3 marks) was challenging for some candidates. This was the first time that candidates were expected to manipulate a formula to calculate the length of the side as required. Despite this being a new type of question, a surprising number of candidates were able to answer this question.

Suggestions for improvement

(a) The use of correct terminology in terms of the different aspects on a building plan is of the utmost importance when teaching this topic. Teachers need to ensure that learners understand the difference between similar aspects of this topic and can distinguish between them.

(b) It will be beneficial to learners if teachers require of them to draw the symbols used on building plans, write the abbreviations and names of these symbols during class and homework activities and give short informal assessments on this topic on a regular basis.

(c) More emphasis should be placed on the development of the skills required to describe and explain concepts in a logical manner.

(d) More analytical questions and worksheets, like those in Q2, should be used in class, focusing on the correct terminology for each part of the drawings as well as the drawing and interpretation of the different symbols.

(e) It will be beneficial to learners if they are exposed to more calculations involving the manipulation of a formula, area, perimeter, and lengths of walls to ensure that they are equipped to respond to these types of questions accurately.

QUESTION 3: CASEMENTS, CUPBOARDS, WALL-PANELLING AND QUANTITIES

Common errors and misconceptions

(a) In Q3.2 (8 marks) many candidates demonstrated a lack of understanding regarding the drafting of a cutting list. Many candidates were not able to distinguish between the width, length and thickness and then they wrote the wrong measurements under the wrong headings.

(b) In Q3.3 (4 marks) many candidates were not adequately equipped to analyse and detect the errors in the given sectional drawing of a casement with a fanlight and were not able to draw the corrected version of the drawing. Some candidates merely redrew the incorrect drawing that was given in the question paper.

(c) In Q3.4 (4 marks) many candidates were not able to reorganise the members of wall panelling in the correct logical sequence.

(d) In Q3.5 (4 marks) most candidates were able to draw the main members of the cupboard, but many candidates demonstrated a lack of understanding with regard to the finer detail at the base of the cupboard.

Suggestions for improvement

(a) More emphasis should be placed on the topic of quantities, especially the use of a cutting list and how to complete it accurately.

(b) It is recommended that questions and exercises that involve the use of 'problem-identifying' and 'problem-solving' skills should be used often, as this is the direction that the subject is leaning towards, and these skills are necessary in the carpentry practice. This will also enable learners to respond better to these types of questions.

(c) It would be beneficial if teachers could use models of wall panelling to enable learners to interpret and understand the different parts and views of wall panelling so that they will be able to organise members in the correct sequence. Regular activities that involve drawing the different members of wall panelling will also improve the learners' understanding of this topic.

(d) It will assist learners greatly if teachers use scale models of cupboards with different layouts and parts as teaching aids from which learners can draw the different views of cupboards so that they can see and understand the composition of the structure of the cupboards. The manufacturing of small cupboards as practical tasks during Grades 10 and 11 will also give learners a better understanding of how these models are assembled and enable them to draw them more accurately.

QUESTION 4: ROOFS, CEILINGS, TOOLS AND EQUIPMENT, AND MATERIALS

Common errors and misconceptions

(a) In Q4.1 (6 marks) many candidates lacked the content knowledge to identify the correct machine that should be used to perform the task as listed in column B.

(b) In Q4.2 (6 marks), candidates found it challenging to respond to the questions regarding preservation of timber.

(c) In Q4.3 (8 marks) most candidates were not sufficiently equipped to represent the pictorial view of the faulty trapdoor installation in a corrected two-dimensional sketch. Many candidates merely copied the incorrect drawing from the question paper.

(d) In Q4.8 (4 marks) many candidates were not able to identify the members of the truss layout of a hipped roof. Most candidates found it challenging to visualise these concepts from a two-dimensional perspective.

Suggestions for improvement

(a) It is advised that learners should be offered the opportunity to use all kinds of equipment and tools during practical sessions to obtain the necessary exposure and experience, which will enable them to respond to these types of questions accurately.

(b) All prescribed topics are important and should be given the necessary time and attention as prescribed by the *Annual Teaching Plan*. Although topics like materials, safety and tools and equipment are dealt with in Grades 10 and 11, they should be dealt with and revised in Grade 12 as well to ensure that the learners are well prepared and able to respond to questions on these topics.

(c) It is recommended that teachers spend more time and conduct more activities to develop their critical thinking, reading and comprehension skills in all topics that lend themselves to these kinds of questions. It is also of the utmost importance that learners are taught the difference between *line diagrams*, *two-dimensional drawings*, *three-dimensional drawings*, *pictorial drawings*, and *scale drawings* as they will be expected to respond to questions using the different types of drawings. If learners use the wrong type of drawing to respond to the question, they may not be credited for the answer provided.

(d) A practical application of this content (building a scale model with all the roof truss members) will assist learners in understanding how the roof members are constructed and connected, as well as the different layouts found in roofs.

QUESTION 5: CENTERING, FORMWORK, SHORING AND GRAPHICS AS MEANS OF COMMUNICATION

Common errors and misconceptions

(a) In Q5.2 (6 marks) most candidates were well-equipped to draw the supporting members of the centring of an arch.

(b) In Q5.3 (5 marks) very few candidates were able to draw the correct placement of the dead shores, needles and braces in a building where repairs need to be done. Many of the candidates who attempted the drawing drew double lines and not a line diagram for the members of the dead shore, which gives the impression that candidates did not know the difference between the different types of drawings.

(c) In Q5.4 (7 marks) many candidates were not able to complete the drawing of the formwork for a landing at a staircase.

Suggestions for improvement

(a) Learners should be exposed to more drawings on centring and the different types of centring, focussing on the logical order in which the different parts of the centre are assembled and the purpose of each member. This may assist learners in understanding the structure and remembering the correct sequence of drawing the members.

(b) It is recommended that teachers should practically demonstrate these topics to provide learners with more exposure, in order to understand the concepts of this topic. Different types of drawings should be practised during teaching and during assessments to ensure that learners know the difference between the different types of drawings and are able to draw a line diagram if that is what is expected from the question.

(c) It will benefit learners if a practical application of this content (building a scale model of a staircase) can be created in class. This will assist learners in understanding how the members are constructed and connected, as well as the different layouts of the stairs.

QUESTION 6: SUSPENDED FLOORS, STAIRCASES, IRONMONGERY, DOORS AND JOINING

Common errors and misconceptions

(a) In Q6.2 (4 marks) most candidates had difficulty describing the methods of joining a door to a frame and a roof truss to a wall plate. Candidates found it difficult to express themselves accurately.

(b) In Q6.3 (6 marks) most candidates' responses reflected that they were not equipped to differentiate between 'staggered struts' and 'in-line struts' used for suspended timber floors.

(c) In Q6.5 (8 marks) most candidates were not familiar with the different parts on the horizontal sectional view of a four-panel door, and could not draw the required sectional view correctly.

(d) In Q6.6 many candidates responded by naming random terminologies, found in different resource materials, that would not be incorrect if the question did not require them to choose the correct terminologies that were listed above the drawing.

Suggestions for improvement

(a) It is recommended that learners are exposed to the different methods of joining different objects to one another during practical periods so that they can easily recall this information when they must respond to these types of questions. This exposure will also enable learners to express themselves more accurately since they will possess sound knowledge of this topic.

(b) It is critically important that learners understand what they are drawing for them to respond correctly to any drawing question. It is therefore recommended that teachers make use of physical examples of every drawing that learners are required to draw. The practical installation of a suspended timber floor with all components during practical periods will also assist learners in gaining a better understanding of this topic.

(c) It will be beneficial to learners if they are exposed to more examples where they are required to produce drawings from given specifications and sectional views to

develop their drawing skills and enable them to respond more accurately to these types of questions.

(d) Learners should be taught to read all the instructions carefully before attempting to answer any question and to understand exactly what is expected of them when reading a question. They should know the meaning of all the different action verbs, for example, define, explain, choose, name etc.

CHAPTER 5

ELECTRICAL TECHNOLOGY

There are three specialisation subjects in Electrical Technology, namely Digital Electronics, Electronics and Power Systems.

A detailed analysis of performance trends is provided for each specialisation subject. It must be noted that the following general comments are observations noted across all three subjects and are therefore stated at the outset.

General comments: Digital Electronics, Electronics and Power Systems:

(a) Questions based on recall of content were poorly answered by the majority of the candidates. Weekly informal assessment tasks should be used to reinforce basic concepts and principles. This can be used effectively for content relating to definitions, functions, labelling and operations as listed in the *CAPS* and the *Examination Guidelines*.

(b) Several candidates encountered challenges in manipulating formulae accurately. The following steps are suggested:
- This skill must be introduced in the Grade 10 and revised in Grade 11 as well in calculation-related topics;
- More informal calculations involving manipulation of formulae must be given to learners as a repetition of doing these types of calculations will improve their skills to master them;
- Identify and use the relevant formulae provided on the formula sheet; and
- Apply the correct substitution and provide the answer with the correct unit and direction in terms of what is required by the question.

(c) Most candidates still experience challenges with questions that require application of mathematical operations.

(d) Candidates must be made aware that their handwriting must be legible, and their calculations should not be cramped onto a section of the page. They must also be taught to follow the general instructions provided on the cover and to read questions carefully so that they are able to answer certain subquestions appropriately.

(f) Some candidates still show a lack of fundamental knowledge and understanding, which they should have gained in Grades 10 and 11. This could be due to the majority of teachers relying on using previous years' question papers instead of using a variety of teaching and learning resources at their disposal, such as the internet as well as the DBE learner study guides.

(g) The lack of content and skills knowledge demonstrated by the candidates in the 2024 examinations, showed poor or inadequate preparation for learning and assessment.

5.1 DIGITAL ELECTRONICS

The following report should be read in conjunction with the Digital Electronics question paper of the November 2024 examinations.

5.1.1 PERFORMANCE TRENDS (2020–2024)

The number of candidates who wrote the Digital Electronics examination in 2024 increased by 25, compared to that of 2023.

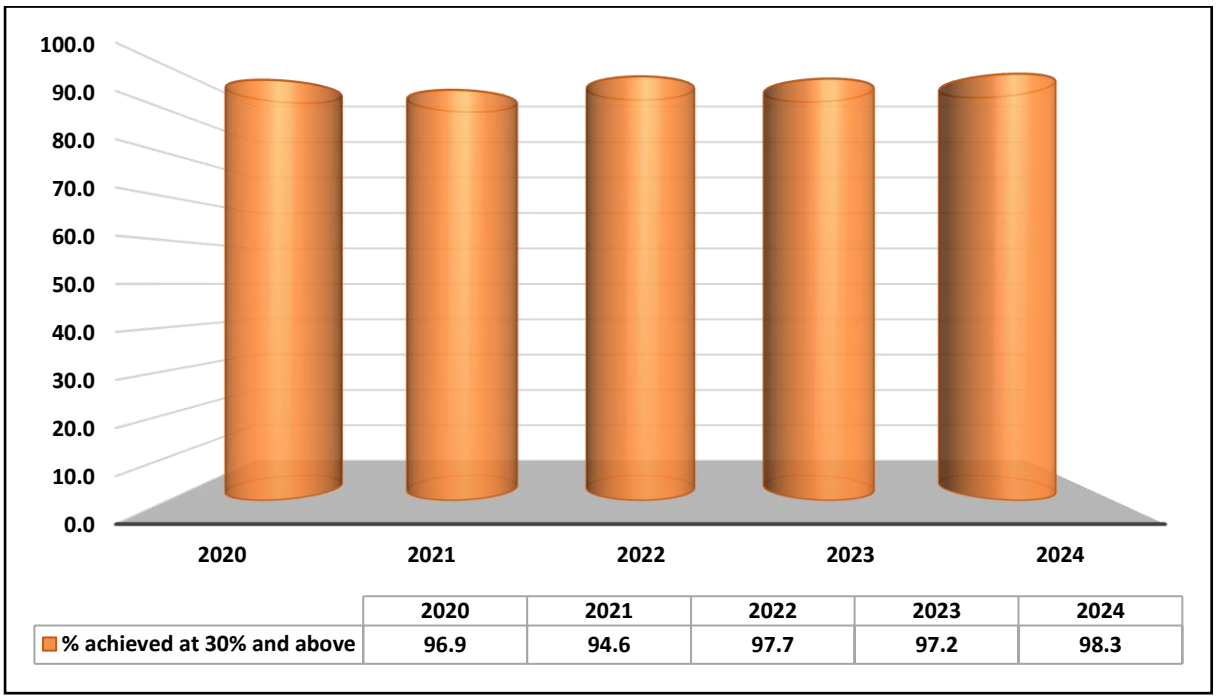
There was a marginal improvement in the pass rate this year. Candidates who passed at the 30% level improved from 97,2% in 2023 to 98,3% in 2024. However, the percentage of distinctions over 80% declined slightly from 1,5% in 2023 to 1,4% in 2024. The total number of distinctions remained consistent for the past two years, with 6 candidates achieving distinctions.

The various commendable intervention strategies employed by the Department of Basic Education subject specialist, provincial subject committee team members, subject advisors, teachers and the provincial education departments played a role in preparing the learners to perform better in 2024. The resourcefulness and diligence of the above-average candidates also contributed to the slight improvement in the subject.

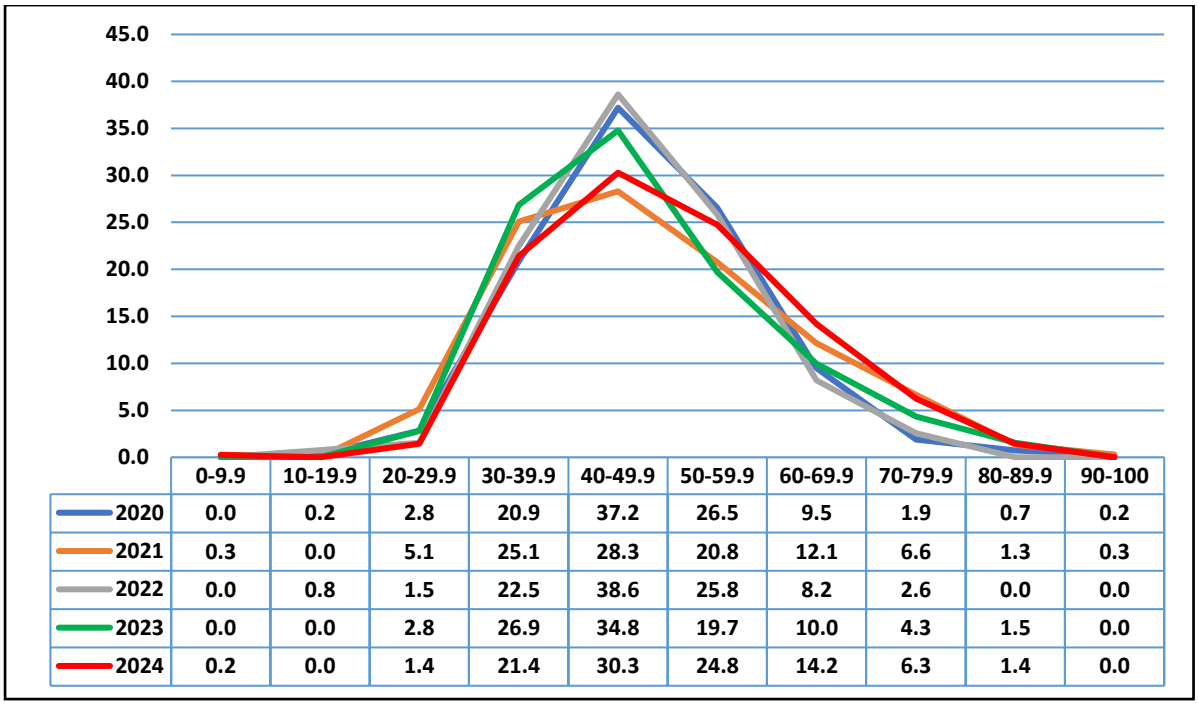
Table 5.1.1 Overall achievement rates in Digital Electronics

Year	No. wrote	No. achieved at 30% and above	% achieved at 30% and above
2020	422	409	96,9
2021	371	351	94,6
2022	391	382	97,7
2023	391	380	97,2
2024	416	409	98,3

Graph 5.1.1(a) Overall achievement rates in Digital Electronics (percentage)



Graph 5.1.1(b) Performance distribution curves in Digital Electronics (percentage)



	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	90-100
2020	0.0	0.2	2.8	20.9	37.2	26.5	9.5	1.9	0.7	0.2
2021	0.3	0.0	5.1	25.1	28.3	20.8	12.1	6.6	1.3	0.3
2022	0.0	0.8	1.5	22.5	38.6	25.8	8.2	2.6	0.0	0.0
2023	0.0	0.0	2.8	26.9	34.8	19.7	10.0	4.3	1.5	0.0
2024	0.2	0.0	1.4	21.4	30.3	24.8	14.2	6.3	1.4	0.0

General comments

To improve learner performance, it is imperative to focus on key areas of difficulty, specifically switching circuits, digital and sequential devices, and microcontrollers. The 2024 NSC examination results underscored the ongoing struggles of many candidates in these subjects.

To further reinforce their understanding, teachers are encouraged to:

- Complete structured practical activities tailored to switching circuits, digital and sequential devices, and microcontrollers; and
- Engage with complex, verb-driven questions (e.g. explain, describe, discuss, state, determine, and motivate) sourced from past examination papers, to hone their critical thinking and problem-solving skills.

5.1.2 OVERVIEW OF CANDIDATES' PERFORMANCE IN DIGITAL ELECTONICS

General comments

(a) Notably, candidates demonstrated poor overall performance, even when faced with questions requiring only basic cognitive skills.

(b) An analysis of candidates' responses revealed significant gaps in their content knowledge and a lack of essential skills to effectively address the questions.

(c) A significant number of candidates struggled to respond to narrative type questions that required the practical application of theoretical concepts and mathematical operations learned from previous grades, e.g.:
- Principle operations of circuits
- Manipulation of formulae
- Analysis of circuit diagrams and reading for meaning

General suggestions for improvement

(a) Past NSC papers can be valuable teaching and learning resources when utilised effectively. These papers can serve multiple purposes:
- Learner assessment and evaluation
- Revision and exam preparation
- Teacher self-diagnostic assessment

(b) The following method must be applied to effectively master responding to narrative types of questions to score maximum marks:
- Long sentences must be avoided
- Facts must be included, and proper subject vocabulary must be used
- The narrative can be written in a bullet or paragraph form
- The narrative must be detailed and well structured

The marking guidelines illustrate this by breaking down answers into key areas of specific content, with marks awarded accordingly. General or vague responses will only receive minimal credit.

(c) To develop their comprehension skills and avoid one-word answers, learners should respond in a bullet format, as demonstrated in the marking guidelines. Refer to specific examples, such as Q3.3.2 and Q6.7.4, in which responses are broken down into bullet points with targeted marks.

(d) To deepen learners' understanding of the subject content, teachers must demonstrate all practical informal tasks outlined at the end of each topic in the *CAPS*. Learners must also perform these practical tasks These hands-on activities will not only solidify theoretical concepts but also prepare candidates for the formal practical assessment tasks (PATs) (Simulations and the Prescribed Project).

(e) Teachers are advised to mark any vague answers wrong throughout the year and provide learners with the correct version of the answers when corrections are done in class. This will also instil skills of reading the questions with meaning in order to respond properly.

5.1.3 ANALYSIS OF CANDIDATES' PERFORMANCE IN EACH QUESTION IN DIGITAL ELECTRONICS

QUESTION 1: MULTIPLE-CHOICE QUESTION

Common errors and misconceptions

(a) A significant number of candidates did not understand how the trigger pulse initiated the output pulse in Q1.3.

(b) Candidates' responses about how a constant input voltage affected the output voltage of an integrator op-amp in Q1.5, were unclear.

(c) Most candidates struggled to answer Q1.10 as they did not know the conditions of the *set/reset* influence on the RS flip flop. They were also unable to answer Q1.12, revealing a significant lack in the understanding of communication peripheral abbreviations.

Suggestions for improvement

(a) Teachers are advised to encourage their learners to consider the following when answering multiple-choice questions:
- Analyse, interpret and reword the questions and do not rush to answer them.
- Provide a possible option/answer before choosing one from the given responses.

(a) Teachers are further advised to provide opportunities to learners to practise the above suggestion by including them in the informal tasks in class. This will hone learners' skills. Continuous practice of these questions in all the topics will result in learners ultimately mastering how to respond well to them.

QUESTION 2: OCCUPATIONAL HEALTH AND SAFETY

Common errors and misconceptions

(a) In their responses to Q2.1, many candidates primarily emphasised safety within the workshop and neglected to address safety in relation to the premises and the course of employment. To improve, candidates should ensure their answers encompass a broader scope, covering all relevant aspects of occupational health and safety.

(b) In their responses to Q2.3, many candidates demonstrated a limited understanding of ventilation and its implications for workplace safety. Specifically, they:
- Focused on the lack of oxygen but were unable to recognise its immediate risks;
- Incorrectly cited Covid-19 and flu as examples of immediate safety risks, rather than emphasising the critical importance of adequate oxygen supply; and
- Revealed a lack of understanding of the term 'ventilation' and its significance in maintaining a safe work environment.

(c) In Q2.4 most candidates repeated the activity/action such as sexual harassment or verbal harassment.

(d) In their responses to Q2.5, many candidates demonstrated misunderstanding and had misconceptions regarding key concepts, inter alia:
- Human rights, victimisation, and discrimination were often used interchangeably, indicating a lack of understanding of these distinct concepts.
- Candidates struggled to differentiate between victimisation and employee rights.
- Some candidates' responses were unclear about what constituted interference with safety equipment in the workshop.
- When discussing safety equipment, most candidates focused on scenarios where equipment was lost or misplaced, rather than the critical issue of damaged equipment rendering it unsafe and potentially leading to accidents.

Suggestions for improvement

(a) To improve learner understanding and responses, teachers are advised to:
- Develop activities that require learners to provide definitions based on the Occupational Health and Safety (OHS) Act, as well as explanations of key concepts and terminologies, and
- Utilise OHS videos to supplement teaching and thereby, guiding learner responses in a more focused and informed direction and in limiting one-word or vague answers.

(b) To achieve better performance, learners must cultivate a more profound grasp of electrical technology concepts and their practical uses. This entails:

- Improving comprehension of complex concepts and relationships;
- Developing description and explanation skills to articulate ideas clearly;
- Enhancing content knowledge to build a stronger foundation;
- Refining language proficiency to accurately convey meaning and understanding; and
- By focusing on these areas, learners will develop a deeper, more nuanced understanding of electrical technology principles and applications.

(c) Teachers should instruct learners to carefully examine the mark allocation for each question before responding. To maximise scores, learners should ensure that their answers provide a corresponding number of relevant facts or points, to align with the allocated marks. This strategic approach will assist learners to efficiently manage their time, provide comprehensive responses, and earn the maximum possible marks.

(d) Learners' responses often lacked specificity and concision, as illustrated by the following example:
- Question: Explain why a person should not interfere with equipment in the workshop that is provided for safety. (2 marks)
- Answer: 'A worker should not interfere with the equipment provided for safety, for then the safety equipment would not be safe to work safe with the equipment.'
- In this instance, the learner's response was vague and circular, essentially rephrasing the question. This resulted in the learner receiving only one of the two possible marks.
- To improve, learners must focus on providing clear, concise, and direct answers that address the question's specific requirements.

QUESTION 3: SWITCHING CIRCUITS

Common errors and misconceptions

The 2024 cohort made similar errors and had the same misunderstandings as their peers of the afore-mentioned years.

(a) In Q3.1, many candidates provided an incomplete response, stating only that 'the output is fed back to the inverting input'. However, the marking guidelines required a more comprehensive answer: 'a portion of the output signal is fed back to the input out of phase'. This highlighted a significant knowledge gap among most candidates, who lacked specific operational knowledge. As a result, these candidates scored only one of two possible marks, underscoring the importance of providing complete and accurate responses.

(b) A significant number of candidates struggled to answer Q3.2 and Q3.3, which required narrative responses. This difficulty was evident in both the main questions and their subquestions. Specific challenges included:
- Interpreting circuit diagrams
- Analysing circuit behaviour
- Understanding circuit operation

(c) Notably, some candidates lacked a basic understanding of how the circuit powered the LEDs and the sequence in which they turned on. This knowledge gap highlighted the need for improved comprehension of fundamental circuit concepts. The monostable multivibrator in Q3.4 posed significant challenges for most candidates, despite being explained in the textbook.

(d) A few candidates could not do the following:
- Accurately draw the output waveform
- Adhere to the specified three-second unstable state, instead drawing waveforms that changed state and remained static
- Explain the chronological operation of the monostable multivibrator
- Understand the influence of the capacitors' time constant on the circuit
- Draw the output waveform correctly, particularly when R_2 and C_2 are stable

(e) In Q3.5 many candidates struggled with:
- Completing the astable multivibrator circuit diagram in Q3.5.1
- Differentiating between the output voltage of a stable multivibrator circuit using 741 op-amp and 555 IC
- Understanding the concept of dual power supply

(f) In Q3.6, several candidates encountered difficulties with:
- Identifying the specific resistor R_2 that sets the reference voltage in the circuit, amidst multiple resistors
- Recognising the components responsible for specific functions in the circuit, as queried in Q3.6.1 to Q3.6.2

(g) In Q3.7, some candidates could not state the application of the *Schmitt trigger*.

(h) In Q3.9 most candidates struggled to:
- Explain the primary function of the passive differentiator
- Draw the correct output waveform for a long constant input over one full cycle

(i) In Q3.10 most of the candidates could not differentiate between *differentiator* and *integrator*, *passive* and *active* circuit.

Suggestions for improvement

(a) The modification of components significantly impacts circuit characteristics and operation. Therefore, it is essential to teach learners how to apply their knowledge to predict output waveforms in dynamic circuits. This requires a teaching approach that emphasises *analysis, critical thinking* and *problem-solving* skills. Q3.4 and Q3.9 highlight the importance of these skills, as learners struggled to understand how changes in circuit components affected output waveforms.

(b) To enhance learner understanding, teachers are advised and encouraged to emphasise the difference between the verbs 'calculate' and 'determine'.
- *Calculate*: This involves identifying relevant formulae, substituting given values, and performing mathematical operations to arrive at a numerical answer.
- *Determine*: In contrast, this verb requires learners to identify and interpret information provided in diagrams, graphs, or text, without performing calculations.

QUESTION 4: SEMICONDUCTOR DEVICES

Common errors and misconceptions

(a) In Q4.1.2 many candidates provided the *characteristics* of the amplifier instead of the *advantages*.

(b) In Q4.1.3 a significant number of candidates struggled to provide a clear explanation of the *common mode rejection ratio* of a 741-op amp.

(c) In Q4.2.2 several candidates encountered difficulties with:
- Using the correct formula to calculates the gain, substituting correctly, calculating and using the correct unit
- Identifying the type of amplifier

(d) In Q4.2.3 most candidates struggled to accurately draw the output waveform on the provided answer sheet. Common errors included:
- Drawing the full waveform without indicating saturation
- Drawing incorrect waveforms, such as square waves or undefined shapes

(e) In Q4.3 most candidates demonstrated a lack of understanding of the internal layout of the 555 IC and the specific functions of its internal components.

(f) In Q4.3.5 a significant number of candidates provided incorrect explanations for the triggering mechanism of the 555 IC.

Suggestions for improvement

(a) Teachers are advised and encouraged to use this format when delivering content:
- Always provide background when introducing topics;
- Definition of concepts and terminologies;
- Basic construction of *op amps*;
- Functional operation and their operating voltages;
- *Op amp* as:
  - *Inverting* and calculations
  - *Non-inverting* and calculations
- Advantages and disadvantages;
- *Open loop* and *closed loop gain* of amplifiers.

(b) It is important to use practically built circuits with voltage measurements in conjunction with the theoretical concepts being addressed.

(c) Understanding of circuit parameters and functions of components in relation to each other must be considered when preparing for examinations.

QUESTION 5: DIGITAL AND SEQUENTIAL DEVICES

Common errors and misconceptions

(a) In Q5.1.1 most candidates could not answer the questions on *polarisation*, particularly with regard to vertical and horizontal planes. Additionally, some candidates could not provide sufficient reasons why light would travel from one grid to the next, rather than passing through the other grid.

(b) In Q5.1.2 most candidates demonstrated a lack of understanding of *matrix control* and its role in displaying images. Many candidates focused on unrelated topics, such as the switching on of different coloured LEDs, and failed to address the core of the question. Furthermore, most candidates struggled to explain how pixels are utilised to create a coherent picture. Some candidates incorrectly focused on the construction of the LCD screen, rather than the process of obtaining a picture, highlighting a knowledge gap in this area.

(c) In Q5.4.1 many candidates used the incorrect gate combinations at parts of the circuit.

(d) In Q5.6 most candidates could not differentiate between the *pulse triggered and edge triggered* concepts.

(e) In Q5.7 most candidates wrote that the decade counter counts to ten. Some left out the reset step.

(f) In Q5.7.1 and Q5.7.2 many candidates could not describe the frequency divider counter and the decade counter. They incorrectly believed that a frequency divider is a circuit that splits a frequency into two separate signals, rather than understanding its true function as a counter circuit that divides the frequency by a predetermined factor.

(g) In Q5.8.3 most candidates could not explain the operation of the register.

(h) In Q5.8.5 many candidates were unable to identify the two primary uses of a parallel-in serial-out shift register.

Suggestions for improvement

The integration of light waves and sound (which is part of the Grade 10 and 11 Physical Sciences curriculum) with digital and sequential devices (which is part of the Grade 12 Digital Electronics curriculum) will better equip teachers to present the polarisation of light.

QUESTION 6: MICROCONTROLLERS

Common errors and misconceptions

(a) In Q6.1 a notable number of candidates incorrectly referred to a 'chip on a computer' instead of the correct term 'computer on a chip'. Unfortunately, this mistake resulted in many candidates losing marks.

(b) In Q6.2 most candidates demonstrated a narrow understanding of the control unit's role, primarily focusing on its instruction-execution capabilities, including the movement of data into and out of memory, as well as the sequential execution of instructions.

(c) In Q6.2.1 many candidates could not label A and B, and some swapped the answers.

(d) In Q6.2.2 many candidates provided explanations that closely resembled the functions of the central processing unit (CPU), rather than the control unit. Candidates appeared to have relied heavily on general computer knowledge, rather than providing precise explanations, which resulted in inadequate differentiation between the two concepts.

(e) In Q6.2.3 many candidates demonstrated a limited understanding of the arithmetic logic unit (ALU). Common errors included:
- Referring to the ALU solely as an arithmetic unit, neglecting its logical functions
- Not mentioning the ALU's data comparison capability
- Providing definitions of the ALU, instead of explaining its functions

(f) In Q6.3 many candidates struggled to differentiate between *discrete* logic and *integrated* logic. While some candidates correctly explained one concept, they often provided incorrect explanations for the other. A common misconception was the reference to 'discrete analogue components', which demonstrated a lack of understanding that, in digital terms, discrete logic refers to a single processor utilising multiple separate logic chips.

(g) In Q6.4 many candidates scored only 1 mark as their only response was that the accumulator stored data.

(h) In Q6.5.1 some candidates provided incomplete answers, failing to mention key aspects of the system bus, including:
- The address bus and data bus
- The system bus's ability to connect and communicate with external devices, effectively linking the microprocessor to the outside world

Many candidates demonstrated a narrow understanding of the system bus, focusing solely on its internal functions within the microprocessor, without acknowledging its role in facilitating communication with external devices.

(i) In Q6.5.2 some candidates could not compare the advantages of synchronous and asynchronous communication.

(j) In Q6.6 a few candidates did not provide a full explanation of the difference between the two protocols of communication, which are half and full duplex.

(k) In Q6.7.1 many candidates wrote the abbreviation 'SDA' as 'Serial Data Address' instead of 'Serial Data Address Line'. Furthermore, a significant number of candidates could not provide the meaning of the abbreviation 'SDA', as their focus was primarily on the functional aspects and circuit diagrams.

(l) In Q6.7.4 most candidates could not explain the master-slave operation of the I^2C bus.

(m) In Q6.9 many candidates drew the process symbol instead of input/output symbol in a flow diagram. They could not label the decision symbol properly with 'Yes'/'No'.

Suggestions for improvement

(a) Teachers are advised and encouraged to:
- Explain terminologies such as 'computer on a chip' and 'Serial Data Address Line';
- Differentiate between *discrete logic* and *integrated logic* and clarify the concept of *discrete logic*;
- Focus on component functions, including the control unit, ALU, and accumulator;
- Ensure learners understand the system bus's role in facilitating communication with external devices.

(b) Teachers should reinforce understanding of digital concepts, including synchronous and asynchronous communication.

(c) Using practical examples and experiments to illustrate key concepts, such as the function of pull-up resistors in microcontrollers will enhance the teacher's lesson.

(d) Regular feedback and assessment opportunities to help learners identify areas for improvement should be provided by the teacher.

(e) Learners should be provided with opportunities to practise drawing and labelling flow diagrams correctly.

5.2 ELECTRONICS

The following report should be read in conjunction with the Electronics question paper of the November 2024 examinations.

5.2.1 PERFORMANCE TRENDS (2020–2024)

The number of candidates who sat for the Electronics examination in 2024 decreased by 51, compared to that of 2023.

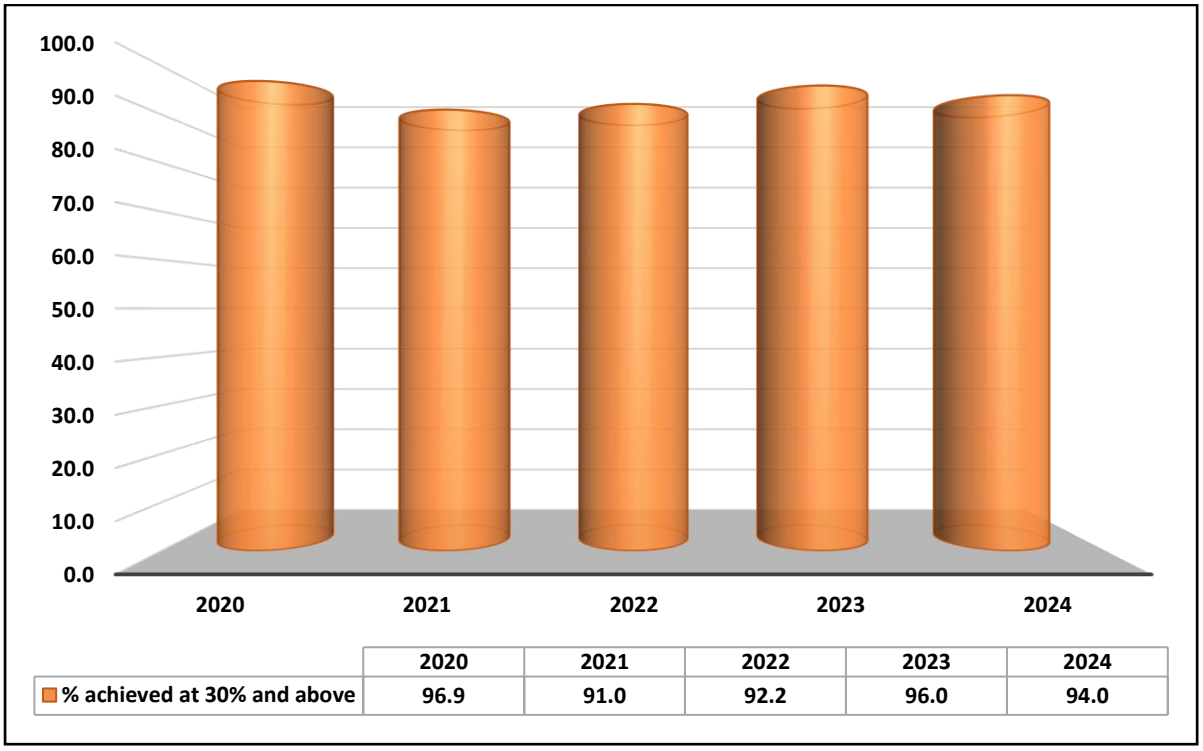
There was a slight decline in the pass rate this year. Candidates who passed at the 30% level decreased from 96,0% in 2023 to 94,0% in 2024. However, the percentage of distinctions over 80% increased from 0,4% in 2023 to 0,8% in 2024. The total number of distinctions increased from 5 distinctions in 2023, to 9 distinctions in 2024.

The various commendable intervention strategies employed by the Department of Basic Education subject specialist, provincial subject committee team members, subject advisors teachers and the provincial education departments played a role preparing the learners to perform better in 2024. The resourcefulness and diligence of the above-average candidates also contributed to the overall performance of the subject.

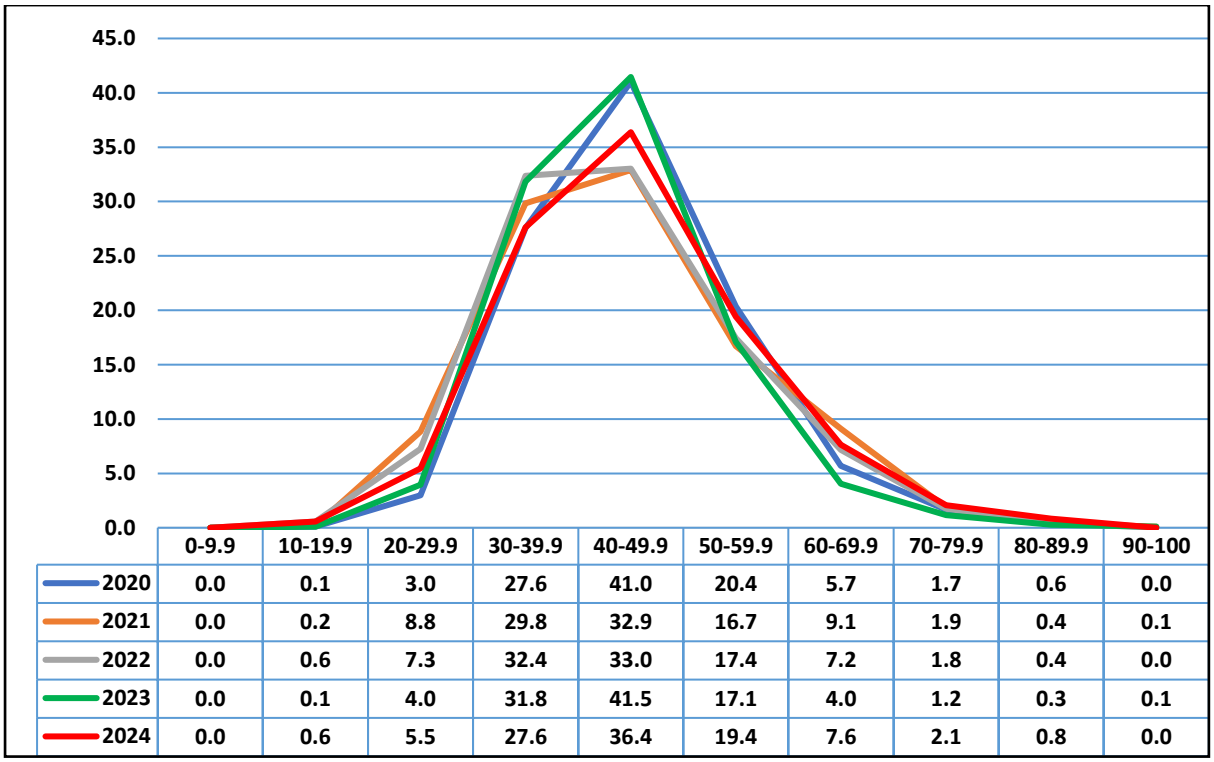
Table 5.2.1 Overall achievement rates in Electronics

Year	No. wrote	No. achieved at 30% and above	% achieved at 30% and above
2020	968	938	96,9
2021	1 143	1 040	91,0
2022	1 199	1 105	92,2
2023	1 112	1 067	96,0
2024	1 061	997	94,0

Graph 5.2.1(a) Overall achievement rate in Electronics (percentage)



Graph 5.2.1(b) Performance distribution curves in Electronics (percentage)



	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	90-100
2020	0.0	0.1	3.0	27.6	41.0	20.4	5.7	1.7	0.6	0.0
2021	0.0	0.2	8.8	29.8	32.9	16.7	9.1	1.9	0.4	0.1
2022	0.0	0.6	7.3	32.4	33.0	17.4	7.2	1.8	0.4	0.0
2023	0.0	0.1	4.0	31.8	41.5	17.1	4.0	1.2	0.3	0.1
2024	0.0	0.6	5.5	27.6	36.4	19.4	7.6	2.1	0.8	0.0

5.2.2 OVERVIEW OF CANDIDATES' PERFORMANCE IN ELECTRONICS

General comments

(a) To improve performance, the following areas: *switching circuits*, *semiconductors* and *amplifiers* need to be covered as it was evident that most candidates continued to struggle with them in the 2024 examination. Curriculum specialists and teachers are urged to attend to these areas of concern as large numbers of candidates still obtained zero marks in these questions.

General suggestions for improvement

(a) *Revision of relevant Grade 10 and 11 content*: Although the NSC examinations only assesses Grade 12 content, prior knowledge from the Grade 10 and 11 syllabi serves as a foundation to equip and prepare learners to respond to Grade 12 content. It is, therefore, imperative that this prior knowledge be incorporated into teachers' lesson preparations/plans.

(b) *Practical experiments and past papers*: At the end of each topic in the *CAPS*, there are practical experiments to be conducted to enhance the understanding of the subject content. Teachers are encouraged to conduct these practical tasks, which will, in turn, prepare candidates for practical assessment tasks (PATs).

(c) It was evident that candidates did not know the effect of altered component values and *input voltages* on the operation and output of circuits. Teachers must demonstrate the effect of different component values and/or input voltages on the operation and output of electronic circuits. These are higher-order concepts that must be demonstrated through practical circuits and displayed on an *oscilloscope*.

5.2.3 ANALYSIS OF CANDIDATES' PERFORMANCE IN EACH QUESTION IN ELECTRONICS

QUESTION 1: MULTIPLE-CHOICE QUESTION

Common errors and misconceptions

Some candidates could not select the correct answers in Q1, which could be attributed to inadequate content knowledge and limited techniques to effectively navigate multiple-choice questions.

Suggestions for improvement

(a) Teachers are advised to encourage their learners to consider the following when answering multiple choice questions:
- Analyse, interpret and reword the questions and do not rush when answering them.
- Mentally provide a possible answer, before choosing from the given options.

(b) Teachers are further advised to provide opportunities to learners to practise the above suggestion by including them in the informal tasks in class This will hone learners' skills. Continuous practice of these questions in all the topics will result in learners ultimately mastering how to respond well to them.

QUESTION 2: OCCUPATIONAL HEALTH AND SAFETY

Common errors and misconceptions

In Q2.1 most candidates could not define the term 'workplace' as it is referred to in the OHS Act; instead, they defined it in their own words, which did not fully meet the required criteria.

Suggestions for improvement

Teachers are advised to develop activities that:
- Require learners to provide definitions based on the OHS Act, which will promote a deeper understanding of key concepts and terminologies.
- Incorporate OHS videos to supplement teaching. This will guide learners to respond more comprehensively and accurately and will discourage them from providing brief or vague responses.

QUESTION 3: RLC CIRCUITS

Common errors and misconceptions

(a) In Q3.3.1 many candidates could not explain RLC parameters, such as capacitive reactance. Notably, this type of question has been problematic for candidates over the years.

(b) In Q3.2.5 most candidates were unable to draw and label the phasor diagram for a parallel RLC circuit. Common errors included:
- Using X_C and X_L instead of V_L and V_C; and,
- Omitting the phase angle 'θ' and direction of rotation.

As a result, candidates lost marks.

(c) In Q3.2.6 while many candidates understood the effect that the decrease in frequency had on X_L and X_C, they lacked the understanding of the resonance concept.

(d) In Q3.3.5 most candidates could not do calculations or omitted the unit.

Suggestions for improvement

Teachers are advised and encouraged to assist learners to differentiate between phasor diagram of series, and parallel RLC circuit by considering the following key parameters:

- Phase angle 'θ' and direction of rotation; and
- The vector V_L and V_C, V_R and I_R.

QUESTION 4: SEMICONDUCTOR DEVICES

Common errors and misconceptions

(a) In Q4.2.1, Q4.2.2, Q4.3.3, Q4.5.2, Q4.7.4, Q4.8.2, and Q4.8.5 most candidates could not explain the operation of the circuits.

(b) In Q4.3 most candidates could not identify the characteristics curve and the labelling of regions. In addition to this, candidates' responses to Q4.3.3 lacked sufficient detail, causing them to lose marks.

(c) Most candidates performed poorly on Q4.5.3 which demonstrated a lack of understanding of the principal operation of the two components.

(d) In Q4.6.3 an overwhelming majority of candidates struggled to provide an explanation of the *common mode rejection ratio*.

Suggestions for improvement

(a) Teachers should emphasise the functions and applications of components in circuit diagrams.

(b) Teachers are advised to distinguish between domestic household and industrial applications of 555 ICs, in their lesson presentation.

(c) Teachers are advised to highlight the differences in the meanings of the following words: 'function', 'use', and 'purpose'. Many learners think that these words are synonyms, and targeted instruction can help clarify this misconception and promote more precise understanding and responses.

(d) To ensure comprehensive understanding and optimal learning outcomes, teachers are advised to concentrate on the following:
    - Consider prior knowledge, learning styles, and preferences (e.g. visual aids, like videos and charts) to ensure that lessons are engaging and interesting;
    - Define key terms and concepts;
    - Explain basic construction and circuit symbols of transistors;
    - Discuss functional operation, operating voltages, and regions of operation.

QUESTION 5: SWITCHING CIRCUITS

Common errors and misconceptions

(a) In Q5.3.2, Q5.4.2 and Q5.4.3 a significant number of candidates could not provide an explanation of the operational principles underlying the given components.

(b) In Q5.5.1 while some candidates successfully drew the circuit, many could not follow the instructions to label all the components. As a result, despite their partial accuracy, these responses were not awarded any marks because essential labels had been omitted.

(c) In Q5.6.2 most candidates would state incorrectly that the LED in FIGURE 5.6 was one of the two components that formed the sensing unit.

(d) In Q5.6.3 and Q5.8.4 many candidates could not explain the operation of the component.

(e) The primary function of the passive differentiator in Q5.9.1 was often simply stated as converting square wave to triangular waves.

(f) In Q5.9.2 most candidates did not draw the correct output waveform; instead, they drew different waveforms.

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Suggestions for improvement

(a) To understand switching circuits, learners should comprehend the following essential concepts:
- Triggering points and output waveform orientation in response to various input signals;
- Active high trigger and active low trigger principles in switching circuits;
- The distinctions between integrator and differentiator circuits when applying input signals;
- The differences between the verbs '*calculate*' and '*determine*'.

(b) In the context of calculation, the following steps are important:
- Identifying relevant formulae;
- Substituting given values into the formulae;
- Performing mathematical operations to arrive at the solution;
- Writing the correct unit to avoid losing marks (See Q5.8.2 and Q5.8.3).

QUESTION 6: AMPLIFIERS

Common errors and misconceptions

(a) In Q6.1 most candidates were unable to describe *attenuation*.

(b) In Q6.2.4 the majority of the candidates plotted the Q-point anywhere on the DC load line, instead of indicating it in the middle at the 6 V position for the Class A amplifier.

(c) Most candidates answered Q6.3.2, and Q6.3.3 poorly and showed no basic understanding of frequency response curves principles.

(d) In Q6.4.4 many candidates stated that the output would be distorted instead of saying there would be a loss of power due to the mismatch in impedances.

(e) In Q6.5.1 and Q6.5.2 most of the candidates could not identify the type of push-pull amplifier circuit diagram and gave the incorrect function of the capacitor.

(f) In Q6.6.3 few candidates were able to draw the curve, and no marks were awarded for incorrect labels.

(g) In Q6.7.1 most candidates answered the freewheeling effect poorly, with a few candidates scoring one mark; however, most candidates were awarded zero marks.

Suggestions for improvement.

To improve learners' understanding and performance, the following is suggested:

- Learners should master definitions and the categories of amplifiers.
- Teachers should focus on:
  - Circuit analysis and component functions;
  - Practical applications and experimentation;
  - Educational software to illustrate abstract concepts;
  - Operation of circuits, including the function of each component;
  - Frequency calculation and oscillation demonstration;
  - Simulation of all the prescribed circuits.

5.3 POWER SYSTEMS

This report should be read in conjunction with the Power Systems question paper and marking guidelines of the November 2024 examinations.

5.3.1 PERFORMANCE TRENDS (2020–2024)

The number of candidates who sat for the Power Systems examination in 2024 decreased by 268, compared to that of 2023.

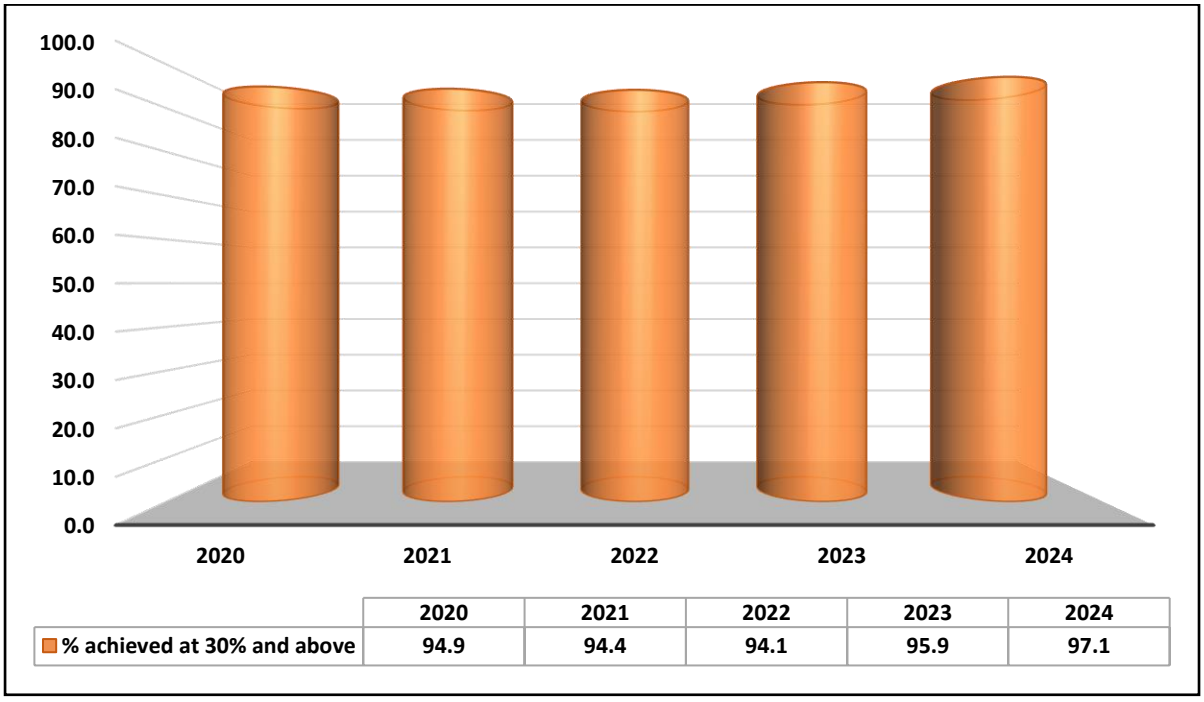
There was a marginal improvement in the pass rate this year. Candidates who passed at the 30% level improved from 95,9% in 2023 to 97,1% in 2024. Despite the decrease in the number of candidates, the percentage of distinctions over 80% increased slightly from 1,1% in 2023 to 1,8% in 2024. The total number of distinctions increased from 65 distinctions in 2023, to 102 distinctions in 2024.

The various commendable intervention strategies employed by the Department of Basic Education subject specialist, provincial subject committee team members, subject advisors, teachers and the provincial education departments played a role preparing the learner to perform better in 2024. The resourcefulness and diligence of the above-average candidates also contributed to the overall improvement in the subject.

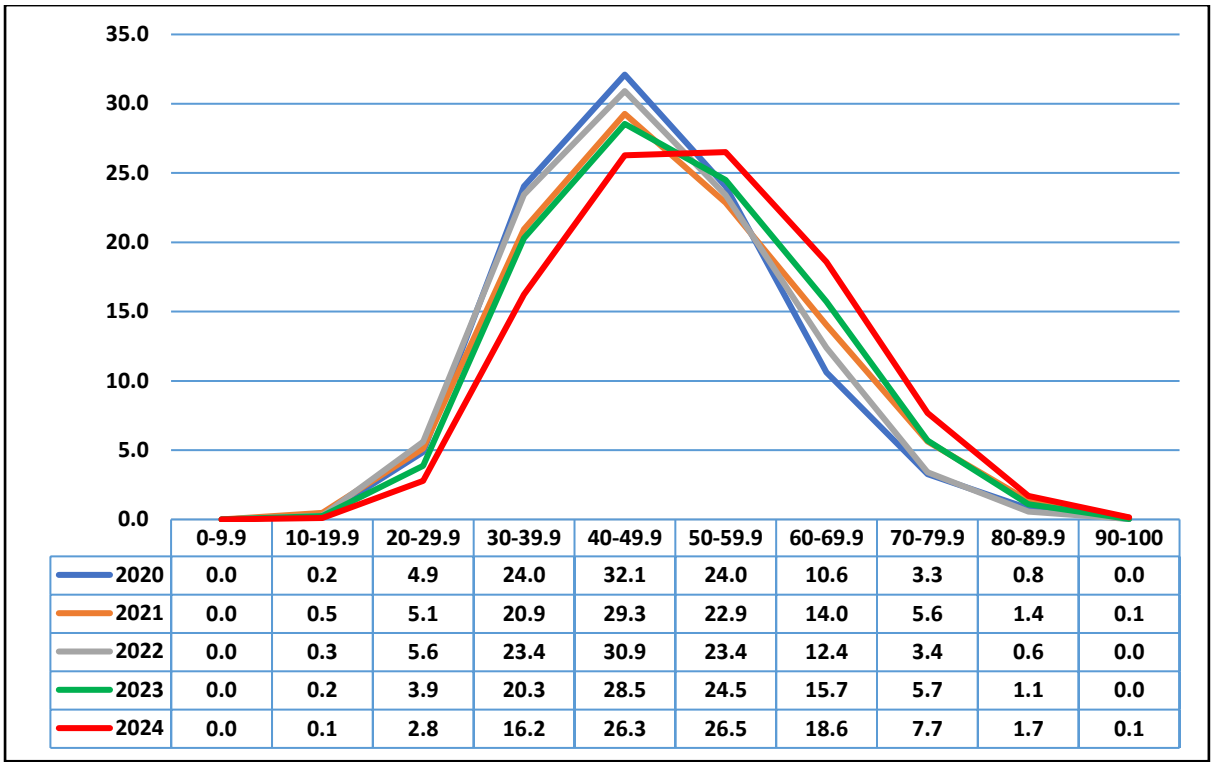
Table 5.3.1 Overall achievement rates in Power Systems

Year	No. wrote	No. achieved at 30% and above	% achieved at 30% and above
2020	4 623	4 387	94,9
2021	5 675	5 357	94,4
2022	5 907	5 561	94,1
2023	5 938	5 694	95,9
2024	5 670	5 506	97,1

Graph 5.3.1(a) Overall achievement rates in Power Systems (percentage)



Graph 5.3.1(b) Performance distribution curves in Power Systems (percentage)



	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	90-100
2020	0.0	0.2	4.9	24.0	32.1	24.0	10.6	3.3	0.8	0.0
2021	0.0	0.5	5.1	20.9	29.3	22.9	14.0	5.6	1.4	0.1
2022	0.0	0.3	5.6	23.4	30.9	23.4	12.4	3.4	0.6	0.0
2023	0.0	0.2	3.9	20.3	28.5	24.5	15.7	5.7	1.1	0.0
2024	0.0	0.1	2.8	16.2	26.3	26.5	18.6	7.7	1.7	0.1

5.3.2 OVERVIEW OF CANDIDATES' PERFORMANCE IN POWER SYSTEMS

General comments

(a) Based on a sample of the candidates' responses, it was evident that most candidates still experienced challenges with interpreting the requirements of the questions and found answering questions of a narrative nature to be challenging.

(b) Questions that required candidates to explain basic operations of circuits still provided a challenge because of a lack of content knowledge and insight into the concepts.

(c) Candidates were unable to select the relevant formula/formulae from the formula sheet, manipulate the formula, substitute correctly, calculate, and provide the correct unit.

(d) The omission of labels in drawings resulted in candidates losing marks.

General suggestions for improvement

(a) Teachers should maintain consistency in assessing drawings across all grades, including those leading up to Grade 12. To emphasise the importance of accurate labelling, teachers should clearly communicate to learners that a correctly drawn diagram without labels will not receive any marks and incorrect labelling on a drawing will also incur penalties.

(b) Manipulation of given formulae is a skill that must be developed and practised throughout the year. All formulae should be provided on the formula sheet before calculations are attempted in each topic. A calculation counting three marks requires the correct formula, substitution, and answer with the correct SI-unit to qualify for three marks.

(c) When answering narrative-type questions with the question verb: 'describe' or 'explain', the mark allocation must be taken into consideration, and the answer should include the number of facts as required by the question. Structuring the response in a bullet form would assist candidates to write one fact per bullet.

5.3.3 ANALYSIS OF CANDIDATES' PERFORMANCE IN EACH QUESTION IN POWER SYSTEMS

QUESTION 1: MULTIPLE-CHOICE QUESTION

Common errors and misconceptions

(a) In Q1.2, Q1.3 and Q1.4 candidates did not understand how RLC parameters affected other parameters. This indicated that they did not understand *impedance, voltage, current* and *quality factor* in the RLC circuit.

(b) In Q1.6 most candidates did not understand the purpose of the neutral conductor in a three-phase AC system.

(c) In Q1.7 most candidates confused a power factor meter with an energy meter, illustrating that candidates did not know the purpose of the power factor.

(d) In Q1.12 many candidates were not familiar with the inner workings of an automatic sequence starter.

(e) Candidates could not manage the following well when they attempted the multiple-choice questions:
- *Absence of process of elimination*: Candidates did not systematically eliminate incorrect options to increase their chances of selecting the correct answer.
- *Distractors that were too similar*: Options that were too similar made it difficult for candidates to distinguish between correct and incorrect answers.

Suggestions for improvement

(a) When answering multiple-choice question teachers are advised to encourage their learners to consider the following:
- Analyse, interpret and reword the questions and do not rush when answering them.
- Provide a possible option/answer before choosing from the given responses.

(b) Teachers are further advised to provide opportunities to learners to practise the above suggestion by including them in the informal tasks in class This will hone learners' skills. Continuous practice of these questions in all the topics will result in learners ultimately mastering how to respond well to them

QUESTION 2: OCCUPATIONAL HEALTH AND SAFETY

Common errors and misconceptions

(a) In Q2.1 most candidates explained the OHS Act and did not answer the question. Some candidates only mentioned one fact and omitted the second fact: 'in the course of employment'.

(b) In Q2.4 candidates confused the term *victimisation* with *human rights* and *employees' responsibilities*. They responded by providing human rights violations instead of

incidents of victimisation. Candidates could also not differentiate between *employer* and *employee* and answered by referring to employee acts and not the employer.

(c) In Q2.5 most candidates provided only one fact; they could not support the first fact by providing a consequence of interfering with safety equipment.

Suggestions for improvement

(d) Teachers are advised to develop activities that:
- Require learners to provide definitions based on the OHS Act, promoting a deeper understanding of key concepts and terminologies; and
- Incorporate OHS videos to supplement teaching. This will guide learners to respond more comprehensively and accurately and will discourage them from providing brief or vague responses.

(e) The following suggestions are still as relevant as they were in the 2021 Diagnostic Report.
- The significance of grasping subject-concepts and terminology are fundamental elements and are critical for achieving a deeper understanding and proficiency of the subject;
- Learners should be encouraged to engage with relevant technical literature, including journals, books, and guides to become familiar with the jargon of the subject.

Following these suggestions will ultimately enhance their comprehension.

QUESTION 3: RLC CIRCUITS

Common errors and misconceptions

(a) In Q3.1.1 many candidates did not refer to *alternating current* in their attempts to explain the term *inductive reactance*, they mentioned 'opposes the flow of current in an inductive circuit' while a few candidates provided the incorrect response.

(b) In Q3.1.2 most candidates could not explain the term *bandwidth.* Those who attempted to explain it, merely wrote the given formula in words.

(c) Most candidates did not identify the type of power factor in Q3.2.1 correctly.

(d) In Q3.2.2, Q3.2.3 & and Q3.2.4 candidates could not manipulate the given formula. A few candidates who managed to manipulate and calculate it correctly, still wrote the wrong SI unit in the answer.

(e) Most candidates did not obtain full marks in the phasor diagram in Q3.2.5. Candidates used the reactance values which are used in the impedance triangle. They ignored the fact that as voltage and current values were given, they were required to draw the voltage phasor diagram. Most candidates omitted the direction of rotation which is a compulsory label in phasor diagrams.

(f) Most candidates struggled with Q3.2.6. A common misconception was the assumption that current and frequency are inversely proportional, without considering the impact of reactance and impedance. Those candidates who attempted the question partially addressed the concept, correctly identifying one or two factors, such as the decrease in inductive reactance (X_L) and capacitive reactance (X_C). However, they were unable to explain how these changes would affect the overall impedance (Z).

(g) In Q3.3.5 most candidates calculated the bandwidth and neglected to include the correct SI unit in their answer, thereby rendering it incomplete.

Suggestions for improvement

(a) To effectively teach phase relationships, teachers are advised to use demonstrations or illustrations to show the phase relationship between current and voltage in the following types of circuits:
- *Resistive* circuit
- *Inductive* circuit
- *Capacitive* circuit

This hands-on approach will help learners to visualise and understand the complex relationships between current and voltage in different circuit types.

(b) To prepare learners for the examination, teachers should compile a comprehensive booklet summarising key definitions, explanations, and descriptions of crucial concepts, including:
- *Inductance*
- *Inductive reactance*
- *Capacitive reactance*
- *Impedance*
- *Lagging and leading power factor*

Teachers should also provide learners with a formula sheet at the start of the year and offer guidance on:
- Identifying the correct formulae for calculations, and
- Applying the formulae appropriately.

(c) The following approach may assist learners to master calculations:
- Introducing straightforward, (lower-order) examples to establish foundational knowledge;
- Gradually incorporating formula manipulation (middle-order) exercises to enhance problem-solving skills;
- After mastering both lower and middle-order calculations, learners should practise questions that require them to extract information from characteristic curves and phasor diagrams, deduce values (higher-order) from circuits (e.g. X_L or X_C, V_L or V_C and I_L, or I_C during resonance) to use in calculations. This approach will promote analytical thinking and application.

(d) When learners draw and complete phasor diagrams, it is essential for them to adhere to conventional standards which include:
- All phasors have arrowheads to indicate direction;
- Orientating phasors in the same direction as a standard phasor diagram;
- Supply current is the reference on the horizontal axis for series circuits;
- Supply voltage is the reference on the horizontal axis for parallel circuits;
- The phase angle is indicated between supply voltage and supply current;
- Labels must include all relevant information and SI-units; and
- Clearly indicate the direction of rotation. Without rotation it is a vector diagram and not a phasor diagram.

(e) Teachers are encouraged to place strong emphasis on the impact of varying supply frequency in RLC circuits. To provide comprehensive understanding, teachers should integrate the following key concepts:
- Characteristics of curves;

- Phasor diagrams of resonance circuits;
- Conditions for series and parallel resonant circuits.

By teaching these concepts simultaneously, teachers can help learners develop a deeper understanding of the complex relationships within RLC circuits and resonance phenomena.

(f) The concept of Q-factor, bandwidth and selectivity are vague concepts for power systems learners. During National Subject committee meetings, these concepts should be clarified and if possible, an intervention booklet should be developed specifically to address the concepts.

QUESTION 4: THREE-PHASE AC GENERATION

Common errors and misconceptions

(a) In Q4.2.1 most candidates were able to indicate the frequency of power generation in South Africa but not the voltage at which it is generated.

(b) Many candidates related Q4.2.2 to small-scale generators used in households instead of large-scale power generation at power stations in South Africa. A number of candidates confused energy sources with byproducts like diesel and fuel.

(c) In Q4.2.3 most candidates excluded the fact that high voltage power lines are used in the transmission process and largely focused on the stepping up and down of voltage only. Some candidates confused transmission with distribution and explained the latter instead of answering the question on transmission of electricity.

(d) In Q4.3.2 most candidates could not label the waveforms correctly and in the correct sequence; some candidates labelled the waveforms correctly but omitted the phase angle of 120º between the phases.

(e) Many candidates omitted or wrote the incorrect SI-unit in the answer for Q4.4.1.

(f) Candidates could not manipulate the given formula correctly in Q4.4.2.

(g) In Q4.4.3 many candidates used $I_L=I_{PH}$ incorrectly when calculating the phase current of the load. This impacted Q4.4.4, the load impedance calculation, as they repeated the error by incorrectly calculating the phase voltage instead of using $V_L=V_{PH}$ for the load impedance calculation.

(h) In Q4.4.5 most candidates omitted the formula and substituted the power factor without writing the formula first. Some candidates whose calculation was correct did not add an SI-unit to their answer.

(i) Most candidates did not know of a method other than capacitors that can be used for power factor correction in Q4.5.1.

(j) Many candidates could not show how capacitors were connected by means of a drawing in parallel to the load in Q4.5.2; other candidates could not draw the capacitor symbol correctly; they drew a line straight through each capacitor making the answer incorrect.

(k) A large number of candidates could not name the preferred wattmeter method to use in Q4.5.3 and the candidates who could respond correctly, were unable to motivate their answers. Some confused the wattmeter with the kilowatt-hour meter.

Suggestions for improvement

(a) To effectively teach the topic of power generation, transmission, and distribution, educators should:
- Clearly differentiate between these three stages; and
- Utilise educational videos to illustrate the network system and to enhance the learners' understanding.

When teaching stages in the *generation, transmission* and *distribution of electricity,* teachers should do the following:
- Explain each stage individually, referencing voltage levels and explaining the reasons for differences, and
- Provide separate facts for each mark allocated (e.g. three distinct facts for a three-mark question).

To facilitate clear and concise responses, consider guiding learners to structure their answers in bullet form, with each bullet point addressing a different fact.

(b) Although power factor correction is mainly done by means of capacitor banks in parallel with the load, learners must know the alternative methods.

(c) Learners must know how power factor correcting capacitors are connected and illustrate it by means of a correctly labelled diagram.

(d) Total power measurement can be done by means of one-, two- or three-wattmeter methods. Candidates must be able to identify the preferred method for any given scenario and be able to motivate why it is the preferred method.

QUESTION 5: THREE-PHASE TRANSFORMER (SPECIFIC)

Common errors and misconceptions

(a) In Q5.1 most candidates omitted the current when explaining the function of a transformer. They did not indicate that the current will step up by the same ratio to which the voltage is stepped down and vice versa.

(b) In Q5.3.2 many candidates did not know the purpose of laminating the iron core of a transformer; those candidates who knew the purpose, could not correlate the reduction of eddy currents to the reduction of heat losses within the transformer core.

(c) Most candidates did not attempt Q5.3.4 and those who attempted it provided incorrect responses.

(d) In Q5.4.1 candidates did not realise that the secondary side of the transformer was connected in star which meant that the phase voltage was $\frac{V_L}{\sqrt{3}}$. Some candidates could not manipulate correctly.

(e) In Q5.4.2 most candidates could not manipulate correctly and substituted the secondary line voltage instead of the secondary phase voltage in the calculation.

(f) In Q5.4.3 many candidates did not write the final answer in the turns ratio notation and some candidates swopped the primary and secondary values thereby making the ratio incorrect, in their final answer.

(g) Most candidates did not understand the meaning of 'defects' in transformers as stated in Q5.5. Most of their responses were on *external factors* instead of *internal*

defects/faults. They were confused and answered the effect of overloading which was heat.

(h) In Q5.6.3 many candidates could not describe the function of the Buchholz relay, those candidates who could, only mentioned one fact in their response, omitting the fact that the Buchholz relay triggers an alarm and isolates the transformer from the supply when the gas formation exceeds a prescribed level. Others explained where the location of the Buchholz relay was, in the transformer.

Suggestions for improvement

(a) A complete answer requires addressing both voltage and current transformations. For instance, if a transformer steps up voltage, learners must also acknowledge that the current will be stepped down by the same ratio, or vice versa, to receive full marks.

(b) All losses in transformers, including hysteresis losses, must be fully explained to learners.

(c) Three-phase transformer calculations are more complex than the calculations of other topics. This is because there are several factors that must be taken into consideration, e.g. primary side values vs secondary side values, star connection vs delta connection, and phase values vs line values. Numbering all primary side values with a subscript '$_1$'and all secondary values with a subscript '$_2$' when writing the formulae will assist learners not to confuse the primary and secondary values in the substitution step when doing calculations.

(d) The transformer equation and turns ratio equation work with phase values only, hence it is important for learners to know the rules for star and delta connections when they are required to do calculations. The answer for a turn's ratio must always be written in the correct notation e.g. = 27:1.

QUESTION 6: THREE-PHASE MOTORS AND STARTERS

Common errors and misconceptions

(a) In Q6.1 most candidates only mentioned one application of a three-phase induction motor within a workshop.

(b) Many candidates did not know the acceptable minimum value of insulation resistance. Some candidates could not identify the error in the diagram for Q6.2.1 and could therefore, not explain the danger of the error when the motor was powered in Q6.2.2.

(c) Most candidates could not draw the connecting plates for the terminal box in FIGURE 6.2 correctly. They merely redrew the terminals of the motor without indicating that the connecting plates needed to connect the motor in delta. Others drew the coils instead of the connecting plates.

(d) In Q6.2.3 some candidates wrote *slip* instead of *% slip* in the formula, and others wrote *per unit slip*, while there were others who did not multiply the equation by 100. Furthermore, some candidates did not write the unit and lost more than 1 mark.

(e) In Q6.3.1 most candidates, divided the total number of poles which was '6' by 2, forgetting that this is a three-phase motor, instead they should have divided by '3' and '2'. The formula was provided on the formula sheet as

$$(pole\ pairs)\ p = \frac{poles\ per\ phase}{2}$$

(f) In Q6.3.2 candidates omitted the SI-unit or wrote it incorrectly as 'rmp' instead of 'rpm or r/min'.

(g) In Q6.3.3 most candidates substituted incorrectly; they substituted the slip as 6 and not as $\frac{6}{100}$ or 6%. Some candidates who substituted correctly, wrote the incorrect SI-unit as stated above. Others were confused by the information given in the question paper and used the 'per unit slip' formula, and not the *percentage slip* formula.

(h) In Q6.4.2 most candidates who attempted the question provided only one fact, omitting the fact that the timer operates its contacts *after the pre-determined time has lapsed*. Candidates could not identify the given symbol of the timer as an 'on-delay' timer. This challenge affected their responses.

(i) In Q6.4.3, most candidates could not explain why MC_2 connected the motor in star in the main circuit.

(j) Candidates misinterpreted the question in Q6.4.4 and started explaining the operation from when the start button is pressed and not from after the 5 second time delay. Those who attempted the question correctly managed to obtain two out of three marks and omitted the energising of MC_3 or de-energising of MC_2. Some candidates confused *contactors* with *contacts* by stating 'the contactor becomes normally open and normally closed' instead of 'de-energising and energising'.

(k) Most candidates substituted the incorrect values in Q6.5.1, they substituted 30 instead of 30 000. Some candidates used the incorrect formula:
$\eta = \frac{P_{IN} - losses}{P_{IN}} \times 100$ instead of $\eta = \frac{P_{OUT}}{P_{OUT} + losses} \times 100$.
Some candidates calculated correctly but omitted the SI-unit; others did not include the x100 in their calculation, leaving the answer as 0,85.

(l) In Q6.5.2 candidates ignored the output power provided in the question statement and given information, which was the clue to use the power formula that included efficiency, e.g. $P_{OUT} = \sqrt{3} V_L I_L Cos\theta\eta$. Some candidates used the correct formula but substituted the efficiency incorrectly as 85 and not $\frac{85}{100}$ or 85%.

(m) In Q6.5.3 many candidates could not calculate the angle correctly; they substituted the power factor into the reactive power formula instead of working out the angle first with $Cos\theta = pf$ and then substituting the angle into the reactive power formula. Some candidates omitted the unit when calculating the angle; others used the incorrect formula when calculating reactive power.

Suggestions for improvement

(a) Applications of three-phase induction motors should be known to the learners, especially with reference to the workshop.

(b) Motor testing was part of the 2024 PAT. All practical activities prescribed in *CAPS* must be done as this will assist learners in to answer questions like Q6.2. When practical activities are done, teachers should explain the purpose and expected values of all electrical tests.

(c) The connection of three-phase motors in star and delta is important. Learners must read their questions thoroughly and know the difference between connecting plates and coils, i.e. coils are connected between terminal U_1 and U_2, V_1 and V_2 and W_1 and W_2, while plates are connected between terminal U_1, V_1 and W_1 for star connection and between terminal U_1 and W_2, V_1 and U_2, and W_1 and V_2 for delta connection.

(d) Teachers should develop more exercises for calculations on speed and slip. Different ways to present the given information to learners will assist them to use it correctly. Learners should not confuse p (pole pairs per phase) with the poles of the motor. The symbol '*p*' as per the provided formula represents the *pole pairs per phase.*

(e) Learners must substitute the value of the slip correctly as $\frac{6}{100}$ or 6% and remember that the SI-unit for percentage slip is %.

(f) Learners must be specific when answering and referring to *contacts* and *contactors* and not confuse the two. Again, a three-mark allocation in a question requires three facts. Structuring the response in a bullet form would assist learners to write one fact per bullet.

(g) Learners should pay close attention when the output power (P_{OUT}) is given and use the power formula that includes efficiency (η) in their calculations. When substituting the efficiency (η) in the formula, it must be correctly substituted as $\frac{85,71}{100}$ or 85,71%.

QUESTION 7: PROGRAMMABLE LOGIC CONTROLLERS (PLCs) (SPECIFIC)

Common errors and misconceptions

(a) Many candidates did not provide complete answers in Q7.1.1. They only wrote *input* and *output*; other candidates wrote *input module* and *output module*.

(b) Candidates could not explain the programme scan cycle completely. Most candidates obtained one or two marks in Q7.1.2. Some candidates explained the complete scan cycle by mentioning only 1 fact for each cycle.

(c) Many candidates could not identify the logic gate in FIGURE 7.2 correctly as an OR gate. Some candidates could not draw the ladder equivalent correctly. The candidates who drew it correctly, used the incorrect output symbol or did not label the diagram.

(d) In Q 7.2.3 most candidates could not complete the truth table, which indicated that there was very little understanding of the content.

(e) In Q7.3.1 most candidates named the different types of inputs used in PLC. They could not name two applications where level sensors were used. Those who obtained marks in Q7.3.2 were not able to give two correct answers. They wrote vague one-word responses, e.g. *tanks*, not expanding their answer by including 'monitoring the fluid level in a tank.'

(f) In Q7.3.3 most candidates could not differentiate between the application of an inductive proximity sensor and a capacitive proximity sensor. Most candidates' answers included only one fact each; candidates did not take the mark allocation of four into consideration, when they answered the question.

(g) In Q7.4 many candidates struggled with the drawing of the ladder diagram. Candidates

closed the given O/L and STOP inputs that were provided making the diagram wrong. Some candidates connected the reverse section of the control circuit straight to the L power rail which bypassed the O/L and STOP functions provided. A few candidates also drew the MC_2 N/C and MC_1 N/C inputs as open, ignoring the fact that they were not connected to hard-wired inputs as the STOP and O/L, but were soft-wired inputs within the programme. Incorrect labelling and incorrect symbols had a negative impact on the performance in this question. Some candidates who managed to draw and label the ladder diagram correctly, did not number their answer.

(h) In Q7.5.1 most candidates could not label parts A, B and C and obtained one or two marks only.

(i) In Q7.5.2 candidates could not name two motors used with VSD; some candidates gave incomplete answers.

(j) Candidates could not explain the function of the DC-to-AC inverter in Q7.5.3 for three marks – most obtained only one or two marks. Most candidates confused the inverting part (DC-to-AC) of the circuit with the converting part (AC-to-DC) of the circuit.

(k) Most candidates could not explain pulse width modulation in Q7.5.4. Those who attempted the question managed to mention only one or two correct facts. They omitted the component used to do the switching and could not elaborate on how the length of a pulse affected the amplitude of the complete strain of pulses.

Suggestions for improvement

(a) The PLC scan cycle is broken into three separate steps that repeats every few milliseconds. Learners should know and understand each step individually.

(b) It is key for learners to recognise the different logic functions so that they can understand the operation of a PLC ladder diagram. Therefore, it is important for learners to know the symbol, ladder equivalent and truth table for each of these functions separately.

(c) Applications of sensors should be answered in a more descriptive manner and not by giving mere one-word responses. Short explanatory statements should be used when naming applications.

(d) The O/L N/C contact and STOP button in the relay control circuits are normally closed field devices (hard-wired inputs) feeding a permanent high or logic 1 level to the input module of the PLC. Therefore, learners must draw them as an open symbol for the programme to function correctly. When they are drawn as a closed symbol in ladder, they will invert the input received on the input module from the external filed device. The logic 1 received from the input module will then be inverted into a logic 0. When the start button is pressed the circuit will not operate. However, the MC_1 N/C and MC_2 N/C inputs in the ladder program are not connected to an external field device but receive their logic input levels from the (MC_1) and (MC_2) outputs at the end of each rung within the ladder program (soft-wired inputs). For them to correctly function as interlocking contacts, they must be drawn closed as they invert the logic input received from (MC_1) and (MC_2).

(e) Variable speed drives are complex devices that operate on a few fundamental principles that were taught in the lower grades. These principles are all applied at a higher level within the VSD. The processes of rectification and filtering (smoothing) were both covered in lower grades. The process of inverting the DC back into AC is a

new concept for Grade 12. However, the use of educational videos can make this abstract section of the work more graphic. Teachers must consider the use of educational videos for this section of the work as even the practical training modules available do not show the inner workings of a variable speed drive.

CHAPTER 6

MECHANICAL TECHNOLOGY

There are three specialisations in Mechanical Technology, namely Automotive, Fitting and Machining and Welding and Metalwork.

A detailed analysis of performance trends is provided for each specialisation subject. It must be noted that the following general comments are observations noted across all three subjects and are therefore stated at the outset.

General comments on Automotive, Fitting and Machining, Welding and Metalwork:

(a) Questions based on recall of content were poorly answered by most of the candidates. Weekly informal assessment tasks should be used to reinforce basic concepts and principles. This can be used effectively for content relating to definitions, functions, labelling and operations as listed in the *CAPS* and the *Examination Guidelines*.

(b) Several candidates encountered challenges in manipulating formulae accurately. The following steps are suggested:

- This skill must be introduced in the Grade 10 and revised in Grade 11 as well in calculation-related topics
- More informal calculations involving manipulation of formulae must be given to learners as a repetition of doing these types of calculations will improve their skills to master them.
- Identify and use the relevant formulae provided on the formula sheet.
- Apply the correct substitution and provide the answer with the correct unit and direction in terms of what is required by the question.

(c) Most candidates still experience challenges with questions that require application of mathematical principles.

(d) Candidates must be made aware that their handwriting must be legible, and their calculations should not be cramped onto a section of the page. They must also be taught to follow the general instructions provided on the cover and to read questions carefully so that they are able to answer certain sub questions appropriately.

(e) Many candidates lacked knowledge of, or exposure to, the use of various tools and equipment.

(f) Some candidates still show a lack of fundamental knowledge and understanding, which they should have gained in Grades 10 and 11. This could be because the majority of teachers relied on using previous years' question papers instead of using a variety of teaching and learning resources at their disposal, such as the internet.

(g) The lack of content and skills knowledge demonstrated by the candidates in the 2024 examinations, showed poor or inadequate preparation for learning and assessment.

(h) Load reduction negatively impacted teaching and learning. Candidates were not exposed to sufficient practical work to complement the theoretical knowledge. The teachers must download the Eskom push app in order to properly plan for the learners' practical tasks by replacing them with theory and vice versa. Candidates were not exposed to sufficient practical work to complement the theoretical knowledge.

6.1 AUTOMOTIVE

The following report should be read in conjunction with the Automotive question paper of the November 2024 examinations.

6.1.1 PERFORMANCE TRENDS (2020–2024)

The number of candidates who sat for the Automotive examination in 2024 increased by 252, compared to that of 2023.

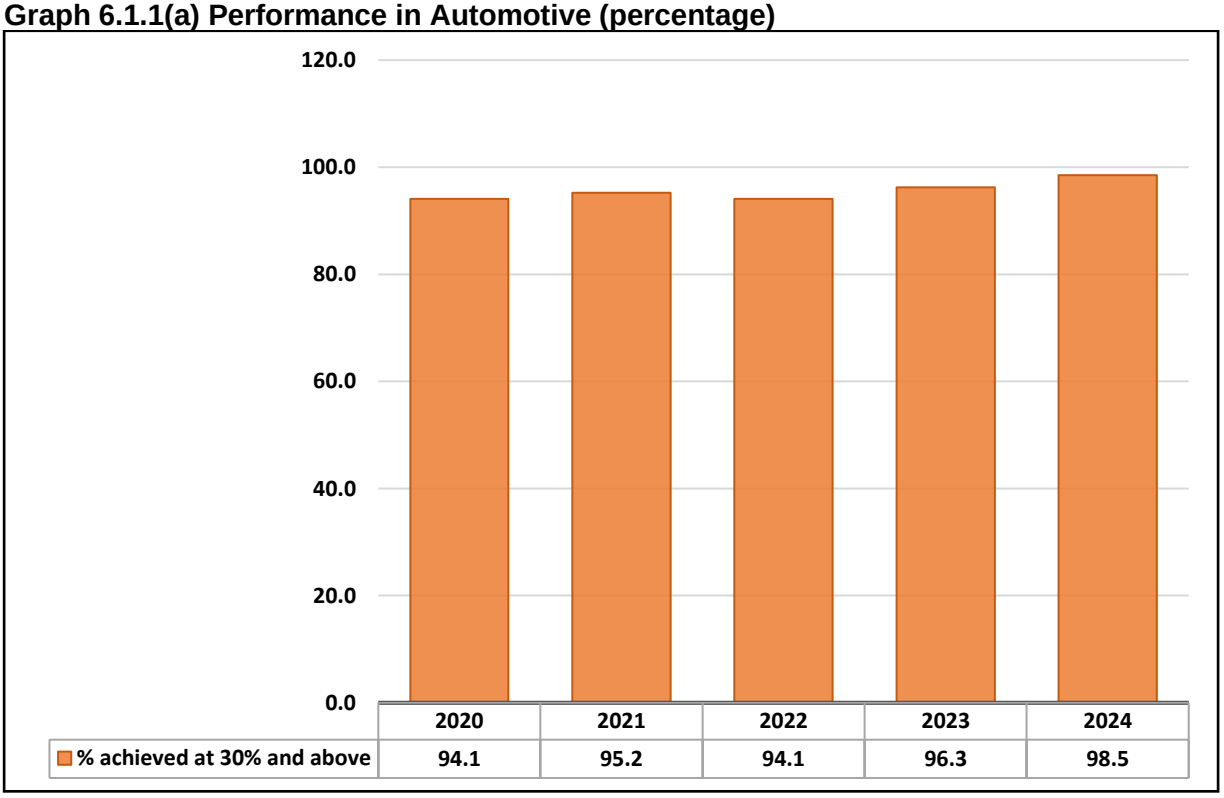
There was a slight improvement in the pass rate this year. Candidates who passed at the 30% level improved from 96,3% in 2023 to 98,5% in 2024. The percentage of distinctions over 80% declined from 1,3% in 2023 to 1,1% in 2024. Given the size of the 2024 cohort, this converts into a decrease in the total number of distinctions from 48 to 44.

The various commendable intervention strategies employed by teachers, subject advisors and provincial education departments were continued in 2024. The resourcefulness and diligence of the above-average candidates also contributed to the overall improvement in the subject.

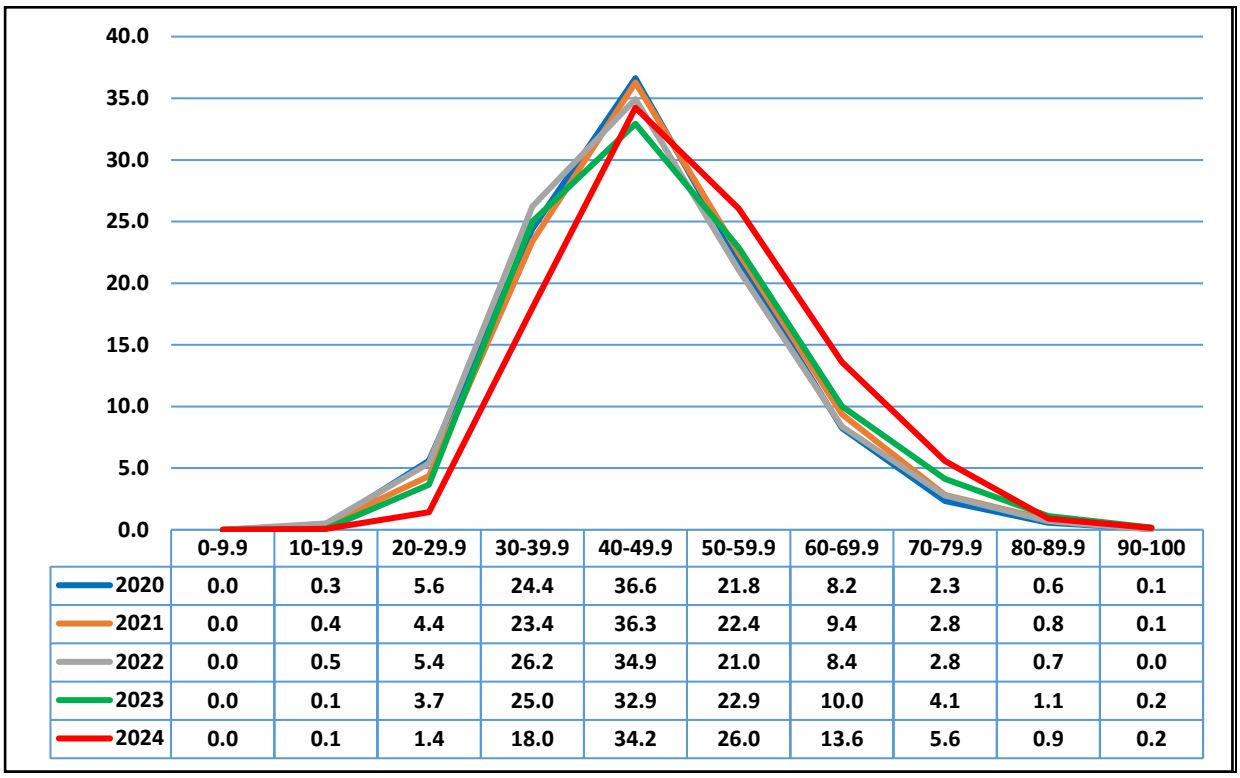
Table 6.1.1 Performance in Automotive

Year	No. Wrote	No. achieved at 30% and above	% achieved at 30% and above
2020	2 839	2 671	94,1
2021	3 330	3 171	95,2
2022	3 601	3 388	94,1
2023	3 711	3 572	96,3
2024	3 963	3 904	98,5

Graph 6.1.1(a) Performance in Automotive (percentage)



Graph 6.1.1(b) Performance distribution curves in Automotive (percentage)



	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	90-100
2020	0.0	0.3	5.6	24.4	36.6	21.8	8.2	2.3	0.6	0.1
2021	0.0	0.4	4.4	23.4	36.3	22.4	9.4	2.8	0.8	0.1
2022	0.0	0.5	5.4	26.2	34.9	21.0	8.4	2.8	0.7	0.0
2023	0.0	0.1	3.7	25.0	32.9	22.9	10.0	4.1	1.1	0.2
2024	0.0	0.1	1.4	18.0	34.2	26.0	13.6	5.6	0.9	0.2

6.1.2 ANALYSIS OF CANDIDATES' PERFORMANCE IN EACH QUESTION IN AUTOMOTIVE

QUESTION 1: MULTIPLE CHOICE QUESTIONS

Common errors and misconceptions

Candidates did not display the basic knowledge and insight needed to answer the questions.

Suggestions for improvement

(a) In-depth revision and remediation measures must be applied regarding the topics of safety and materials. In order to prepare learners to respond with reasons to multiple-choice questions, the use of past question papers or weekly informal assessments is encouraged. They must then apply their practical knowledge to the theory questions.

(b) Learners should be taught how to use the elimination technique to get the correct answer in instances where they are unable to identify the correct alternative.

QUESTION 2: SAFETY

Common errors and misconceptions

(a) In Q2.1 many candidates failed to understand the question. The question specifically asked about safety precautions for the horizontal band saw after it has been switched on. However, candidates provided general safety precautions for the band saw instead.

(b) In Q2.4 and 2.5 the majority of the candidates could not distinguish between the process and product workshop layouts.

Suggestions for improvement

(a) Learners should be constantly exposed to workshop practice relating to the safety of tools, equipment in the workshop and the workshop environment.

(b) Learners should be exposed to good examples of the different workshop layouts to ensure understanding of the layouts.

QUESTION 3: MATERIALS

Common errors and misconceptions

(a) In Q3.3 most candidates were not able to give the effects on metal if it is heated too fast during the heat-treatment process.

(b) In Q3.4 many candidates' responses exposed a lack of theoretical knowledge as well as practical application with regard to heat-treatment processes.

Suggestions for improvement

(a) Teachers must ensure that learners are exposed to the different processes to enhance the properties of steel.

(b) The revision programme must include exercises requiring explanation, definition and application of heat-treatment processes. Schools need to organise educational excursions to foundries or other places where materials are processed to acquaint learners with metallurgy and to further improve their understanding of the processes involved.

QUESTION 4: MULTIPLE CHOICE QUESTIONS

Common errors and misconceptions

Most of the multiple-choice questions were incorrectly answered by a fair percentage of candidates. This was due to candidates' poor content knowledge.

Suggestions for improvement

Learners should be taught how to arrive at the correct answer through using the elimination technique in instances where they are unable to identify the correct alternative.

QUESTION 5: TOOLS AND EQUIPMENT

Common errors and misconceptions

(a) In Q5.1.3 majority of the candidates were unable to give a reason why the ignition system must be disconnected when a compression test is performed in the cylinder.

(b) In Q5.3 most of the candidates stated four safety precautions that must be observed when performing exhaust gas analysis.

Suggestions for improvement

(a) Teachers must ensure that practical simulations are fully explained and emphasised in their lessons and during their weekly informal assessments to enhance better

understanding of theory.

(b) Teachers are strongly advised to expose learners to all tools and equipment as prescribed in the *CAPS* for Automotive. They must also incorporate the correct training on how to use this equipment.

(c) Practical skills in performing compression tests must be incorporated into the teaching of this content. Novice teachers need training in the use of specialised equipment before imparting this knowledge to learners. Subject advisors must take the initiative to identify such teachers and design programmes to assist them.

QUESTION 6: ENGINES

Common errors and misconceptions

(a) In Q6.4 most candidates demonstrated a lack of content knowledge of conducting firing orders in the engine.

(b) In Q6.7.1 many candidates could not differentiate between the usage of turbochargers and superchargers.

Suggestions for improvement

(a) Teachers are encouraged to relate theory with practical demonstration while teaching engines, using visual examples.

(b) It is important that learners can distinguish between the operation of turbochargers and superchargers when dealing with engines in the workshop. Also, teachers must develop worksheets to enhance this aspect of their teaching.

QUESTION 7: FORCES

Common errors and misconceptions

(a) Most candidates struggled to define the engine terminology (clearance volume and compression ratio) in Q7.1.1 and Q7.1.2 respectively.

(b) In Q7.5 most candidates had trouble calculating the power strokes in a four-stroke four-cylinder engine. They could not convert standard units to the required units. Many candidates were challenged by the mathematical concepts which are essential for such calculations.

Suggestions for improvement

(a) Teachers are advised to design worksheets to cater for definitions of terminology involving forces, such as *swept volume, clearance volume, compression ratio*, *indicated power*, *brake power* and *mechanical efficiency*.

(b) The manipulation of formulae forms the basis of calculations in the subject. Learners must be assisted to acquire this skill. Teachers should be given more activities on calculations using examples from previous question papers and various textbooks.

(c) Discuss each step in the calculation using the indicated power and cylinder volume formulae. Teachers should illustrate the steps involved in doing each subcalculation indicating the conversion of the unit separately and then applying these results in the

main formula.

(d) Mathematical skills can only improve with practice. The following steps are suggested:
- Identify the formula
- Formula manipulation (if necessary)
- Substitution (correct values or units)
- Answer with unit of measure indicated

QUESTION 8: MAINTENANCE

Common errors and misconceptions

(a) In Q8.5 most candidates were unable to tabulate the causes and possible corrective measures regarding the high pressure reading during a fuel pressure test.

(b) Q8.7 most candidates struggled to state functions of the radiator cap.

Suggestions for improvement

(a) When conducting the fuel pressure test, teachers are advised to design a worksheet requiring learners to indicate faults and possible causes. This can be done in a table format for differentiating the causes related to corrective measures.

(b) A practical demonstration of how to do a pressure test on a radiator cap is a useful teaching technique in this regard.

(c) Teachers are also encouraged to use video clips relating to safety measures when conducting all types of tests in the engine.

QUESTION 9: SYSTEMS AND CONTROL (AUTOMATIC GEARBOX)

Common errors and misconceptions

(a) In Q9.2 most candidates demonstrated little knowledge of the operation of the torque converter.

(b) Most candidates struggled to draw and label the sketch of a single epicyclic gear system in Q9.3.

Suggestions for improvement

(a) More informal class activities in the form of revision must be given regularly to learners to improve their understanding and lessen content gaps.

(b) Teachers should assign more drawing exercises to allow learners to master all epicyclic gear systems, definitions, and labels. Alternatively, videos can be used to achieve this objective.

(c) Teachers should use charts to show the labels of the automatic gearbox, its advantages, functions, and its operation. If possible, use a sectioned automatic gearbox or an actual vehicle and videos to show learners the differences in the operation of the power transmission between automatic and manual vehicles.

QUESTION 10: SYSTEMS AND CONTROL (AXLES, STEERING GEOMETRY AND ELECTRONICS)

Common errors and misconceptions

(a) The majority of candidates struggled to state faults on the vehicle suspension that could cause camber tyre wear in Q10.1.2 and Q10.1.3.

(b) In Q10.5.5 most candidates demonstrated little knowledge of electronic devices used in the ignition system.

Suggestions for improvement

(a) Teachers should assign more drawing exercises to allow learners to master all wheel alignment angles, definitions, and labels. Alternatively, videos can be used to achieve this objective.

(b) Teachers must introduce the practical application of a steering mechanism so that learners can have a better understanding of the topic.

(c) The use of videos is advised to show the basic operation of an engine's electronic devices in the vehicle.

(d) Weekly short informal assessment tasks to enhance learners' knowledge and drill revision work, must be an ongoing feature of the assessment programme.

6.2 FITTING AND MACHINING

The following report should be read in conjunction with the Fitting and Machining question paper of the November 2024 examinations.

6.2.1 PERFORMANCE TRENDS (2020–2024)

The number of candidates who sat for the Fitting and Machining examination in 2024 decreased by 62 compared to that of 2023.

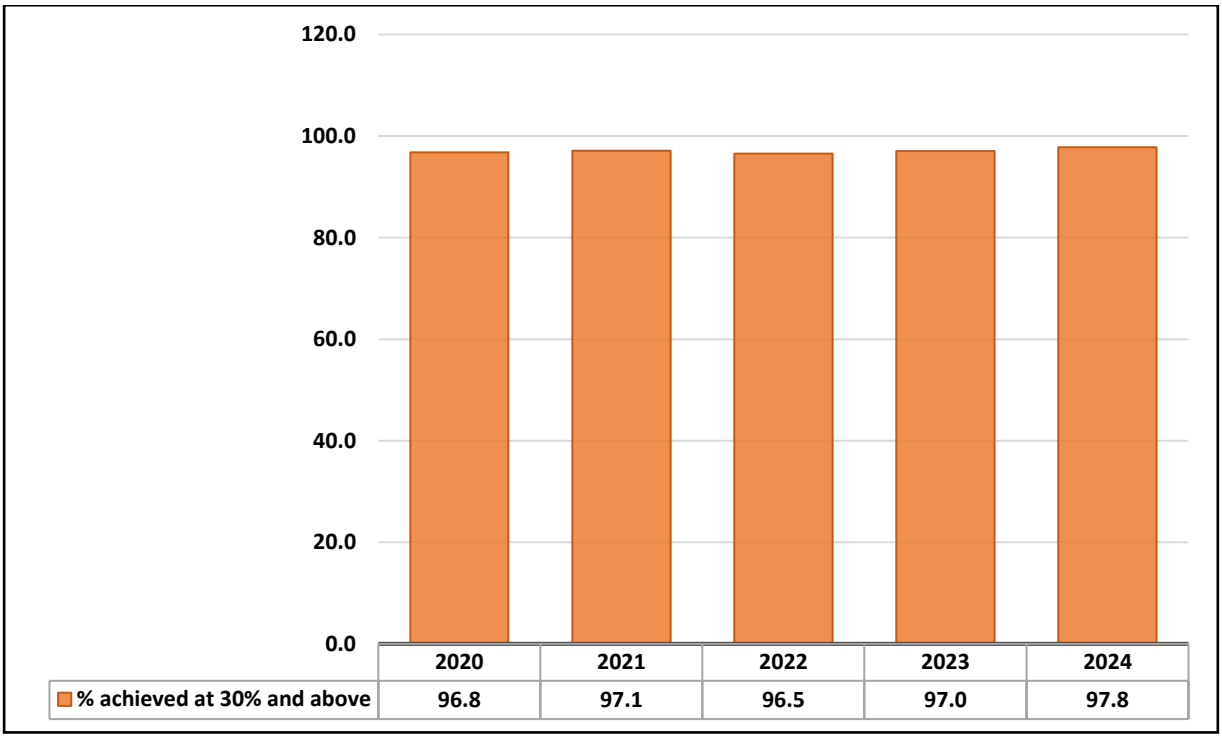
There was a slight improvement in the pass rate this year. Candidates who passed at the 30% level improved from 97,0% in 2023 to 97,8% in 2024. The percentage of distinctions over 80% improved from 3,2% in 2023 to 4,3% in 2024. Given the size of the 2024 cohort, this converts into an increase in the total number of distinctions from 65 to 84.

The various commendable intervention strategies employed by teachers, subject advisors and provincial education departments were continued in 2024. The resourcefulness and diligence of the above-average candidates also contributed to the overall improvement in the subject.

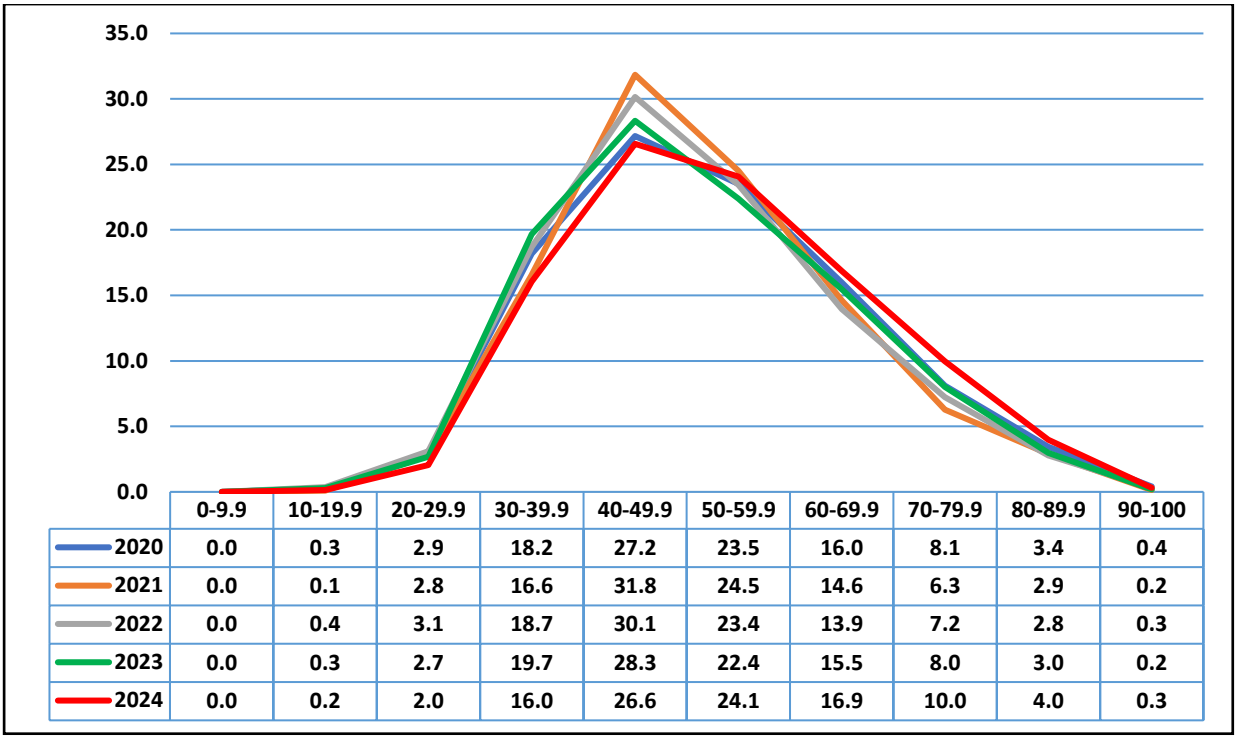
Table 6.2.1 Performance in Fitting and Machining

Year	No. wrote	No. achieved at 30% and above	% achieved at 30% and above
2020	1 914	1 853	96,8
2021	1 991	1 933	97,1
2022	1 937	1 870	96,5
2023	2 019	1 959	97,0
2024	1 957	1 914	97,8

Graph 6.2.1(a) Performance in Fitting and Machining (percentage)



Graph 6.2.1(b) Performance distribution curves in Fitting and Machining (percentage)



	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	90-100
2020	0.0	0.3	2.9	18.2	27.2	23.5	16.0	8.1	3.4	0.4
2021	0.0	0.1	2.8	16.6	31.8	24.5	14.6	6.3	2.9	0.2
2022	0.0	0.4	3.1	18.7	30.1	23.4	13.9	7.2	2.8	0.3
2023	0.0	0.3	2.7	19.7	28.3	22.4	15.5	8.0	3.0	0.2
2024	0.0	0.2	2.0	16.0	26.6	24.1	16.9	10.0	4.0	0.3

6.2.2 ANALYSIS OF LEARNER PERFORMANCE IN EACH QUESTION IN FITTING AND MACHINING

QUESTION 1: MULTIPLE CHOICE QUESTIONS

Common errors and misconceptions

Candidates did not display the basic knowledge and insight needed to answer the questions. Candidates left blank spaces and did not attempt an answer the multiple-choice questions.

Suggestions for improvement

(a) Comprehensive review and remediation efforts should focus on the topics of safety and materials. Incorporating past question papers into weekly informal assessments is recommended, as this will help learners improve their ability to answer multiple-choice questions. Additionally, they should apply their practical knowledge to address theoretical questions effectively.

(b) Teachers are encouraged to guide learners in using the elimination technique to determine the correct answer when they cannot immediately identify the right option.

QUESTION 2: SAFETY

Common errors and misconceptions

(a) In Q2.1, many candidates failed to understand the question. The question specifically asked about safety precautions for the horizontal band saw after it had been switched on. However, candidates provided general safety precautions for the band saw instead.

(b) In Q2.4 and Q2.5 most candidates could not distinguish between the process and product workshop layouts.

Suggestions for improvement

(a) Learners should be regularly exposed to workshop practices focusing on the safety of tools, equipment, and the overall workshop environment.

(b) Learners should be exposed to good examples of the different workshop layouts to ensure understanding of the layouts.

QUESTION 3: MATERIALS

Common errors and misconceptions

(a) In Q3.3 most of the candidates were not able to give the effects on metal if it is heated too fast during the heat treatment process.

(b) In Q3.4 many candidates' responses exposed a lack of theoretical knowledge as well as practical application with regards to heat treatment processes.

Suggestions for improvement

(a) Teachers must ensure that learners are exposed to the different processes to enhance the properties of steel.

(b) Revision programmes should include exercises that focus on explaining, defining, and applying heat-treatment processes. Schools should arrange educational excursions to foundries or facilities where materials are processed to familiarise learners with metallurgy and enhance their understanding of these processes.

QUESTION 4: MULTIPLE-CHOICE QUESTIONS

Common errors and misconceptions

(a) It was disappointing to observe that a significant number of multiple-choice questions were answered incorrectly by many candidates due to inadequate content knowledge. Some candidates even left blank spaces where answers were required.

Suggestions for improvement

(a) Learners should be taught how to use the elimination technique to arrive at the correct answer in instances where they are unable to identify the correct alternative.

(b) Teachers should expose learners to multiple-choice questions in all informal assessments on a weekly basis. This will contribute to providing them with the necessary skills on how to approach these questions.

QUESTION 5: TERMINOLOGY – LATHE AND MILLING MACHINE

Common errors and misconceptions

In Q5.2 candidates were asked to calculate the length (d) of the taper. However, many struggled to manipulate a simple fraction, resulting in an unnecessary loss of marks. While most candidates completed the first step correctly, the subsequent calculations were often incorrect.

Suggestions for improvement

(a) Teachers need to integrate relevant sections with Mathematics (trigonometric equations) and Technical Mathematics.

(b) Teachers should provide learners with a variety of weekly activities that incorporate different questioning techniques, such as substitution, formula manipulation, and calculations. This method will improve their ability to perform well in tests and examinations.

(c) Learners must be encouraged to practise using the diagrams in question papers to assist them in formulating the calculations.

(d) Participating in hands-on activities helps learners understand concepts and processes, as well as their advantages and disadvantages, thereby improving the quality of their responses to questions.

(e) Mathematical skills can only improve with practice. The following steps are suggested:
- Identify the formula
- Formula manipulation (if necessary)
- Substitution (correct values or units)
- Answer with unit of measure indicated

QUESTION 6: TERMINOLOGY – INDEXING AND DOVETAILS

Common errors and misconceptions

(a) In Q6.3.1 most candidates could not perform the fraction calculations for Indexing.

(b) Q6.3.2 required the candidates to calculate change gears. Unfortunately, very few candidates could perform this calculation correctly.

(c) It was disappointing to note that many candidates still struggled with basic fraction calculations. This is a skill that is developed from previous grades over time.

Suggestions for improvement

(a) It is advisable to integrate relevant subject content with Mathematics and Technical Mathematics. Teachers should provide learners with supplementary activities that incorporate various questioning techniques, such as substitution, formula manipulation and calculations, to enhance these skills.

(b) Learners must be offered practical exposure to the machines and equipment. Teachers are requested to use such opportunities to explain the calculations relevant to the tasks.

(c) Teachers should incorporate additional calculation activities into their lesson planning when teaching this content. One or two activities only is insufficient to improve a learner's calculation skills significantly. This approach will reinforce learners' mathematical abilities and improve their proficiency in manipulating formulae.

QUESTION 7: TOOLS AND EQUIPMENT

Common errors and misconceptions

(a) In Q7.1 most candidates did not demonstrate proper knowledge of the Brinell Hardness tester.

(b) In Q7.2 many candidates could not label the different parts of a screw thread micrometer.

(c) In Q7.6 most candidates demonstrated a lack of knowledge of the usage of an interchangeable rod on a depth micrometer.

Suggestions for improvement

(a) It is essential for learners to be familiar with the names and functions of the measuring instruments they use. Teachers can create practical tasks to improve measuring skills, utilising tools such as Vernier callipers, micrometers, and other related accessories.

(b) Teachers should make more extensive use of electronic media and practical exercises to cover the content on testers used to determine specific properties of materials and the application of measuring equipment.

(c) Learners must be made aware of the usage of the Brinell Hardness tester. Short class practical demonstrations are useful to achieve this goal.

QUESTION 8: FORCES

Common errors and misconceptions

(a) In Q8.1 most of the candidates neglected to use the hint provided in the question. The failure of candidates to change the pushing force to a pulling force resulted in incorrect answers. The other concern is that candidates exchanged the HC(X) and VC(Y) components, resulting in incorrect answers.

(b) In Q8.2 most candidates struggled with the correct distance of the uniform distributed load on the beam as the question required reactions at support A and B; instead they calculated reaction B at A and reaction A at B.

(c) Many candidates did not convert answers to the correct units before and after completing the calculation, as required in the question, e.g. MPa and mm.

(d) Numerous candidates found Q8.3 challenging due to calculations involving the calculation of the diameter. They struggled with manipulation, to specify the necessary units of measure, and many candidates faced difficulties in working with formulae related to stress calculations.

Suggestions for improvement

(a) It is recommended that drawing a diagram is an effective way that will assist learners in determining the direction of the resultant. Teachers must make more extensive use of this technique.

(b) Learners must be directed to a common understanding of the principle used to calculate reactions. 'Calculate A, take moments about B' and 'Calculate B, take moments about A' is a recommended example to achieve this outcome.

(c) Learners should be encouraged to perform calculations systematically. The following steps are effective by the few who employ them:
- Identify/Use the correct formula. (This may be on the formula sheet.)
- Manipulate the formula, if necessary, depending on the information available.

- Substitute correct values or units, as per the question.
- Express the final answer with the relevant unit of measure.

(d) Learners must ensure that they use exponents and the correct derived unit in the answer.

(e) A variety of calculation methods should be explored and explained to learners. It is crucial to practice manipulating formulae, with a thorough explanation of the importance of each element within the formula.

(f) Different scenarios must be practised. These can easily be incorporated in homework and weekly assessment activities.

QUESTION 9: MAINTENANCE

Common errors and misconceptions

(a) Q9.3 that tested gear drive content, was poorly answered by many candidates. It was disappointing to note that this content had not been adequately covered or had not been taught at all in some cases.

(b) The inappropriate answers of many of the candidates was also a clear indication that they lacked practical experience in Q9.7 which required the candidates to distinguish between the thermo-hardened or thermoplastic composites.

(c) A considerable proportion of candidates faced challenges in delineating the uses of various materials. This not only indicates a deficit in studying the chapter but also reflects a lack of general knowledge.

Suggestions for improvement

(a) Resources on this content are readily available on the internet. It is recommended that teachers make use of videos and other visual resources during the lessons.

(b) It should be acknowledged that a complete understanding of maintenance procedures cannot be attained solely through textbooks or notes. Observation or practical application is essential.

(c) Teachers should create additional practical tasks that focus on maintenance procedures, ideally presented in bullet points. It is also important to emphasise the correct use of maintenance-related terminology. Integrating theory and practice in the workshop is essential.

QUESTION 10: JOINING METHODS

Common errors and misconceptions

(a) In Q10.1 many candidates lacked relevant knowledge with regard to screw-thread terminology. Candidates often failed to calculate the pitch and pitch diameter, which involved substitution and manipulation. Candidates lost marks when they either substituted incorrectly or failed to manipulate the values properly.

(b) In Q10.3 on labelling square screw-thread, candidates displayed poor knowledge of square-screw threads.

Suggestions for improvement

(a) Teachers need to make sure that lesson plans include clear directions to ensure that learners know and understand screw-thread terminology.

(b) Learners should engage in extra practice sessions focused on calculations to gain confidence in answering this type of question. Regular activities should be scheduled at key intervals throughout the academic year.

(c) Learners must be encouraged to work systematically through the calculations according to the following steps:
- Identify the relevant formula
- Manipulation of the formula (if necessary)
- Substitution (correct values or units)
- Answer with unit of measure

QUESTION 11: SYSTEMS AND CONTROL

Common errors and misconceptions

(a) A large percentage of candidates answered Q11.1.1, Q11.1.2, and Q11.1.3 poorly, likely due to a lack of mathematical skills and knowledge of hydraulics. Candidates lost marks when the first calculation was incorrect, leading to further errors in subsequent calculations. It was clear that candidates struggled with calculating the displacement of the piston.

(b) In Q 11.5.1 and Q11.5.2 many candidates were not able to apply the formula correctly and expressed the answer in the incorrect unit of measure, in their attempts.

(c) In Q11.6.1 many candidates did not calculate the *rotation frequency* of the output shaft.

(d) Q11.6.2 was answered very poorly as candidates did not display the necessary skill to calculate gear ratio.

Suggestions for improvement

(a) Mathematical skills improve through practice. Teachers must provide numerous opportunities, including exercises and homework, to ensure learners master the calculations.

(b) Learners must work systematically through the calculations according to the following steps:
- Formula Identification
- Formula manipulation (if necessary)
- Substitution (correct values or units)
- Answer with unit (Pay attention to requirements in the question.)

(c) The practical application of this content will help learners better understand it. The subject should be integrated with Mathematics, Technical Sciences, and Technical Mathematics.

(d) Teachers must ensure that they also include the theoretical knowledge regarding the systems covered in this chapter.

6.3 WELDING AND METALWORK

The following report should be read in conjunction with the Welding and Metalwork question paper of the November 2024 examinations.

6.3.1 PERFORMANCE TRENDS (2020–2024)

The number of candidates who sat for the Welding and Metalwork examination in 2024 increased by 44 compared to that of 2023.

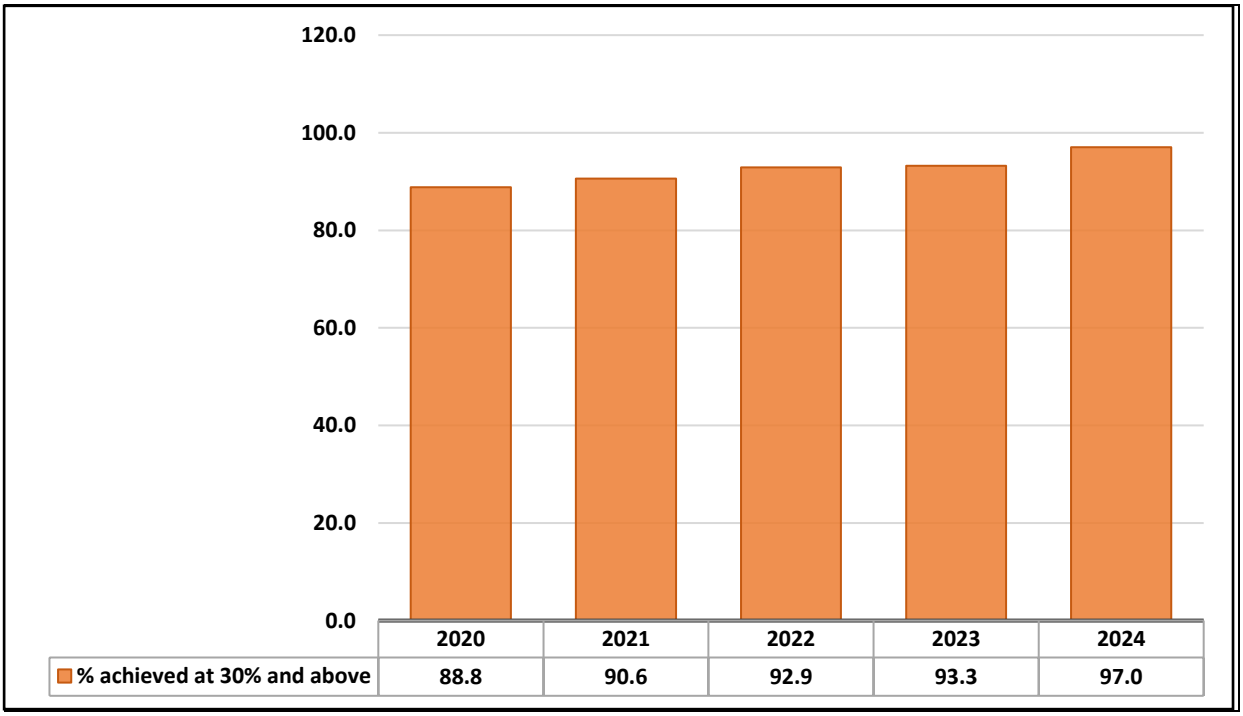
There was a marginal improvement in the pass rate this year. Candidates who passed at the 30% level improved from 93,3% in 2023 to 97,0% in 2024. The percentage of distinctions over 80% improved from 0,7% in 2023 to 1,2% in 2024. Given the size of the 2024 cohort, this converts into a decrease in the total number of distinctions from 17 to 29.

The various commendable support programmes employed by teachers, subject advisors and provincial education departments were continued in 2024. The resourcefulness and diligence of the above-average candidates also contributed to the overall improvement in the subject.

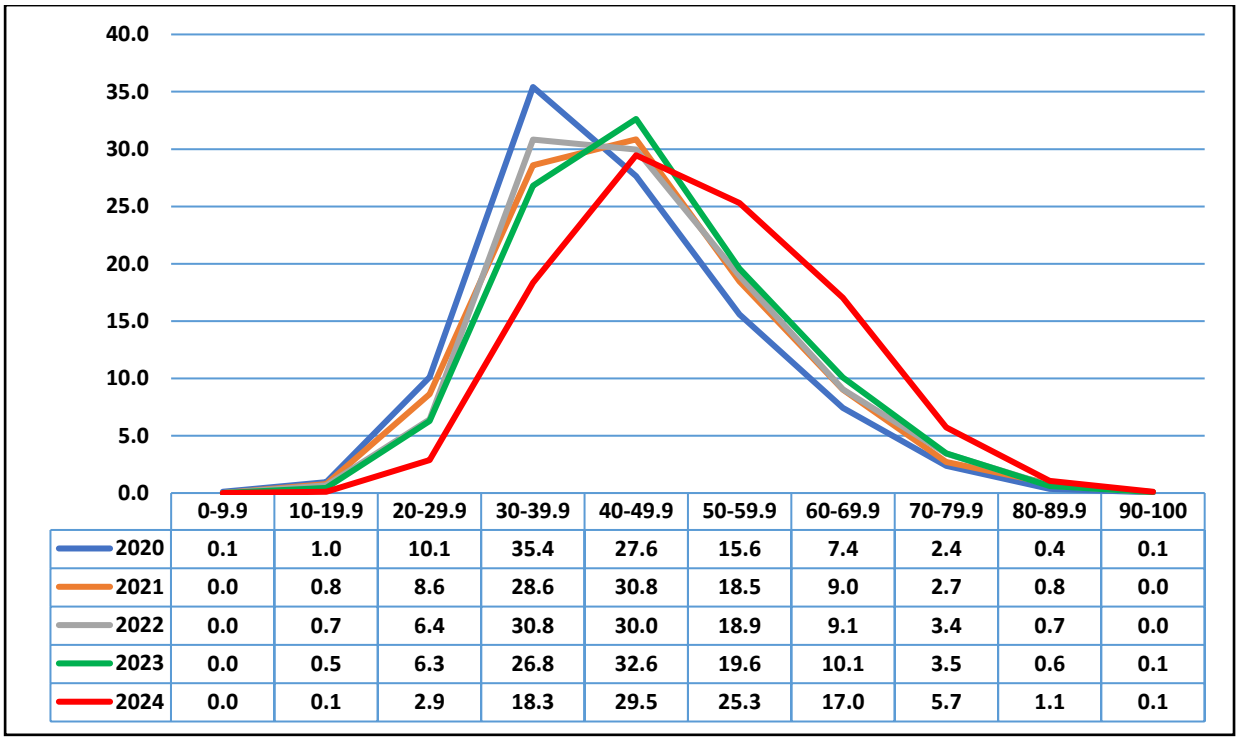
Table 6.3.1 Performance in Welding and Metalwork

Year	No. wrote	No. achieved at 30% and above	% achieved at 30% and above
2020	1 683	1 495	88,8
2021	2 308	2 091	90,6
2022	2 397	2 227	92,9
2023	2 400	2 238	93,3
2024	2 444	2 371	97,0

Graph 6.3.1(a) Performance in Welding and Metalwork (percentage)



Graph 6.3.1(b) Performance distribution curves in Welding and Metalwork (percentage)



	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	90-100
2020	0.1	1.0	10.1	35.4	27.6	15.6	7.4	2.4	0.4	0.1
2021	0.0	0.8	8.6	28.6	30.8	18.5	9.0	2.7	0.8	0.0
2022	0.0	0.7	6.4	30.8	30.0	18.9	9.1	3.4	0.7	0.0
2023	0.0	0.5	6.3	26.8	32.6	19.6	10.1	3.5	0.6	0.1
2024	0.0	0.1	2.9	18.3	29.5	25.3	17.0	5.7	1.1	0.1

6.3.2 ANALYSIS OF LEARNER PERFORMANCE IN EACH QUESTION IN WELDING AND METALWORK

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Common errors and misconceptions

Candidates did not have the basic knowledge and insight needed to answer the questions.

Suggestions for improvement

(a) In-depth revision and remediation measures must be undertaken on the topics of safety and materials. In order to prepare learners to respond with reasons to multiple-choice questions, the use of past question papers and weekly informal assessments is encouraged. Learners must then apply their practical knowledge to the theory questions.

(b) Learners should be taught how to use the elimination technique to arrive at the correct answer in instances where they are unable to identify the correct alternative.

QUESTION 2: SAFETY

Common errors and misconceptions

(a) In Q2.1 most candidates did not read the question properly. The question was about the safety precautions for the horizontal band saw after it has been switched on. Candidates give general safety precautions for the band saw.

(b) In Q2.4 and 2.5 most candidates could not distinguish between the process and product workshop layouts.

Suggestions for improvement

(a) Learners should be constantly exposed to workshop practice relating to the safety of tools, equipment in the workshop and the workshop environment.

(b) Learners should be exposed to good examples of the different workshop layouts to ensure understanding of the layouts.

QUESTION 3: MATERIALS

Common errors and misconceptions

(c) In Q3.3 most of the candidates were not able to give the effects on metal if it is heated too fast during the heat-treatment process.

(d) In Q3.4 many candidates' responses exposed a lack of theoretical knowledge as well as practical application with regards to heat treatment processes.

Suggestions for improvement

(a) Teachers must ensure that learners are exposed to the different processes to enhance the properties of steel.

(b) The revision programme must include exercises requiring explanation, definition and application of heat treatment processes. Schools need to organise educational excursions to foundries or other places where materials are processed to acquaint learners with metallurgy and to further improve their understanding of the processes involved.

QUESTION 4: MULTIPLE CHOICE QUESTIONS

Common error and misconception

Some candidates left blank spaces in some of the questions. They did not attempt to respond which could have resulted in some marks being earned.

Suggestion for improvement

(a) Learners should be taught how to use the elimination technique to arrive at the correct answer in instances where they are unable to identify the correct alternative immediately.

(b) Teachers should expose learners to multiple-choice questions in all informal assessments on a weekly basis. This will contribute to providing them with the necessary skills to approach these questions.

QUESTION 5: TERMINOLOGY

Common errors and misconceptions

In Q5.5 and 5.6 many candidates lacked the necessary knowledge to draw or interpret the welding symbols correctly.

Suggestions for improvement

Learners need to be exposed to more practical application of theory/welding symbols as this will improve the understanding and interpretation of the symbols.

QUESTION 6: TOOLS AND EQUIPMENT

Common errors and misconceptions

(a) In Q6.1 most candidates could not explain the working principles of the punch and cropping machine and the resistance welding machine. Many candidates stated the functions of these machines.

(b) Candidates had difficulty stating more uses of the drill press other than drilling in Q6.2.

(c) In Q6.4 many candidates could not explain the procedure when conducting a Brinell hardness test correctly.

Suggestions for improvement

(a) Teachers must focus on the correct terminology with regard to the different equipment used in the Welding and Metalwork workshop.

(b) Teachers are advised to utilise electronic media to introduce the working principles, functions and procedures of equipment that is not available in the workshop.

(c) Teachers should show learners the practical components of the workshop equipment and ensure that learners use machines frequently in the workshop. In addition, field trips should be organised to visit manufacturing sites/industries where this equipment is being fully used.

QUESTION 7: FORCES

Common errors and misconceptions

(a) In Q7.1.1 some candidates calculated the reactions at RL and RR incorrectly. Utilising these incorrect values in the following subquestions resulted in more mistakes. However, marks were awarded for the correct substitution.

(b) In Q7.1.2 many of the candidates were unable to calculate the bending moments correctly and because of that mistake, the diagram in Q7.1.3 was also drawn incorrectly.

(c) In Q7.2 some candidates had difficulty in calculating stress and strain correctly because of their lack of mathematical skills. It was evident that these candidates could not manipulate the given formula. Using the correct value or unit was also a challenge to many candidates.

(d) In Q7.3 many candidates were not familiar with the procedure to determine the magnitudes and nature of the members in a framework.

Suggestions for improvement

(a) Learners must be provided with opportunities to enhance their mathematical skills at regular intervals. Supporting subjects like Mathematics, Technical Mathematics and Technical Sciences should emphasise relevant sections related to forces.

(b) Diverse calculation methods should be explored and elucidated for learners. Practice in manipulating formulae is essential, and the significance of each element in the formula should be expounded upon comprehensively.

(c) Learners must be directed to a common understanding of the principle used to calculate reactions. 'Calculate RL, take moments about RR' and 'Calculate RR, take moments about RL' is a recommended example to achieve this outcome.

(d) Teachers must emphasise the procedure to determine the magnitudes and nature of the members in a framework (space diagram, planning diagram, vector diagram/scale and then tabulating the final answers).

QUESTION 8: JOINING METHODS – WELD INSPECTION

Common errors and misconceptions

(a) In Q8.2 and 8.3 many candidates could not state the causes and preventative measures for welding defects.

(b) Some candidates did not know the reasons for conducting the machinability test on a welded joint.

(c) Many candidates had difficulty labelling the FIGURES in Q8.4 and 8.7, using the specific terminology.

Suggestions for improvement

(a) Teachers should expose learners to practical work to bring the theoretical subject matter closer to the learners' understanding.

(b) Teachers are encouraged to use previous examination papers for revision especially when preparing learners for tests and examinations.

(c) Teachers should emphasise the use of videos and other electronic media during class lessons. Field trips should be arranged to sites where welding inspections are conducted.

(d) Teachers should focus on using the correct terminology during the teaching process. Learners must also be encouraged to use the correct terminology in answering questions.

QUESTION 9: JOINING METHODS – STRESSES AND DISTORTION

Common errors and misconceptions

(a) In Q9.1 most candidates were unable to state the factors that have an effect on grain size of steel when it is being cold worked.

(b) Many candidates had difficulty stating factors that affect distortion and residual stress in welding in Q9.2.

(c) In Q9.6 many candidates were not familiar with the definitions of distortion and elastic deformation.

Suggestions for improvement

(a) Learners should be exposed to videos during lessons as well as simulations on the effects of cooling rate on a welded joint, as well as the effects of hot and cold working on steel.

(b) This section consists of factual information and teachers should conduct thorough revision to ensure that learners become familiar with the content. Practical exposure will also improve the understanding of the content.

QUESTION 10: MAINTENANCE

Common errors and misconceptions

(a) In Q10.3 most of the candidates were unfamiliar with the negative impact of overloading equipment in the Welding and Metalwork workshop.

(b) In Q10.2 many candidates were unable to state the reasons why a lack of lubrication can lead to machine malfunction.

Suggestions for improvement

(a) Learners should be exposed to the different kinds of equipment and their working principles to enhance understanding of the required maintenance. Informal assessment tasks will support the teaching and learning process.

(b) Teachers must involve learners in the maintenance of the equipment and make learners responsible for specific maintenance tasks in the workshop.

(c) Schools must be sufficiently equipped with the relevant equipment and tools to ensure that practical lessons can take place to develop skills and reinforce the theory.

QUESTION 11: DEVELOPMENT BY CALCULATIONS

Common errors and misconceptions

Q11 required specific mathematical knowledge and skills from the candidates who should be proficient in performing calculations. Candidates struggled with this question because they demonstrated a lack of specific mathematical knowledge and skills.

Suggestions for improvement

(a) Different methods to derive an answer should be explored as learners might not understand one method but might be able to understand an alternative method.

(b) Teachers must make use of past exam papers for revision and remedial work in preparation for the assessment tasks planned. Furthermore, integration with Mathematics could assist in improving long term performance.

(c) Teachers should incorporate a greater number of calculation activities into their lesson planning and assessment when teaching this content. This practice will augment learners' mathematical skills and refine their proficiency in manipulating formulae.

CHAPTER 7

ENGINEERING GRAPHICS AND DESIGN

The following report should be read in conjunction with the Engineering Graphics and Design question papers for the NSC November 2024 examinations.

7.1 PERFORMANCE TRENDS (2020–2024)

The number of candidates who sat for the Engineering Graphics and Design examinations in 2024 increased by 500, compared to that of 2023.

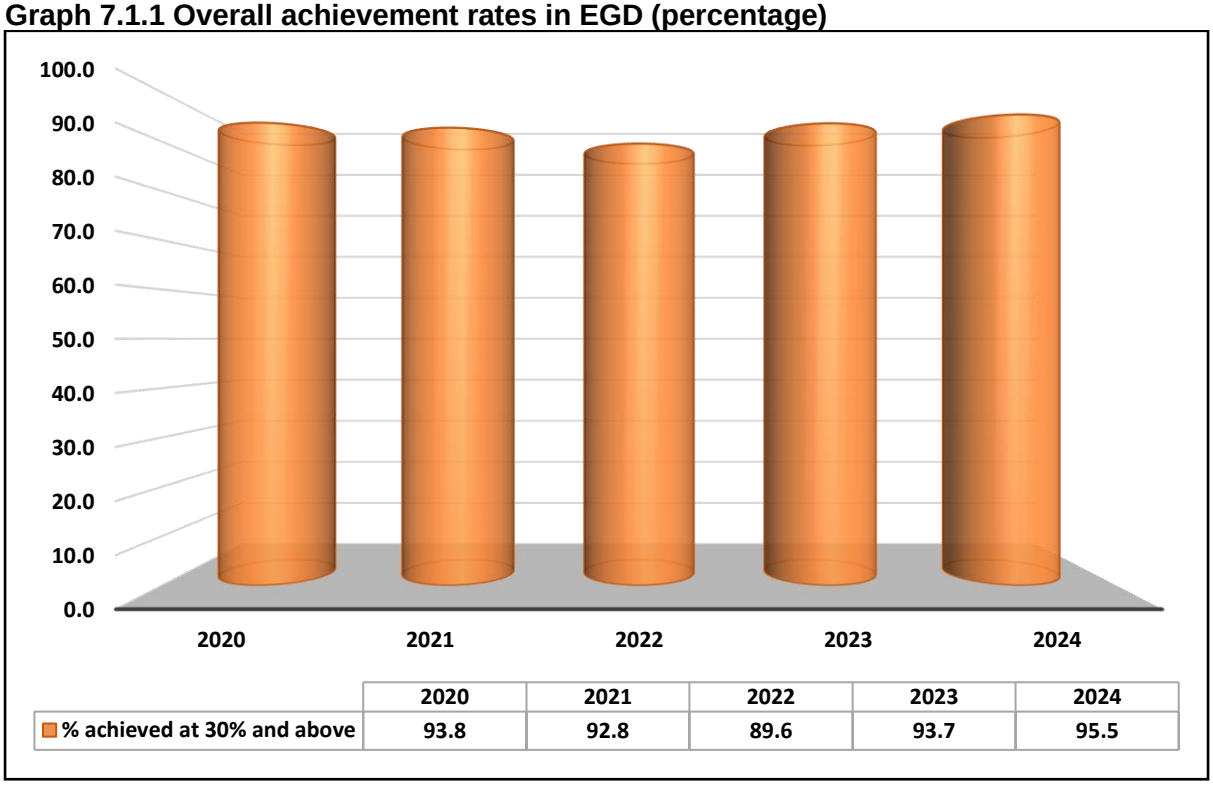
There was a significant improvement in the pass rate this year. Candidates who passed at the 30% level improved from 93,7% in 2023 to 95,5% in 2024. The percentage of distinctions over 80% improved from 5,6% in 2023 to 5,9% in 2024. Given the increase in the size of the 2024 cohort, this converts into an increase in the total number of distinctions from 2 128 to 2 272.

The various commendable intervention strategies employed by teachers, subject advisors and provincial education departments were continued in 2024. The resourcefulness and diligence of the above-average candidates also contributed to the overall improvement in the subject.

Table 7.1.1 Overall achievement rates in EGD

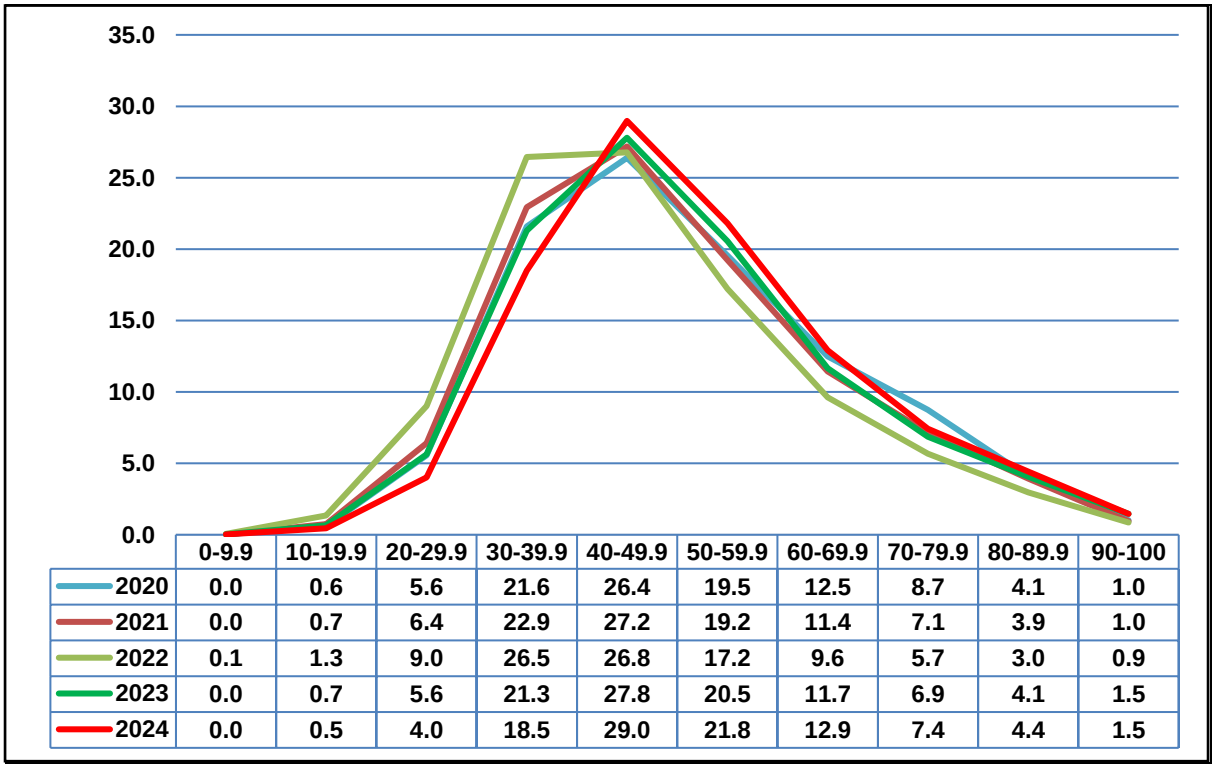
Year	No Wrote	No. achieved at 30% and above	% achieved at 30% and above
2020	32 538	30 529	93,8
2021	37 131	34 463	92,8
2022	38 879	34 830	89,6
2023	38 006	35 603	93,7
2024	38 506	36 771	95,5

Graph 7.1.1 Overall achievement rates in EGD (percentage)



	2020	2021	2022	2023	2024
% achieved at 30% and above	93.8	92.8	89.6	93.7	95.5

Graph 7.1.2 Performance distribution curves in EGD (percentage)



	0-9.9	10-19.9	20-29.9	30-39.9	40-49.9	50-59.9	60-69.9	70-79.9	80-89.9	90-100
2020	0.0	0.6	5.6	21.6	26.4	19.5	12.5	8.7	4.1	1.0
2021	0.0	0.7	6.4	22.9	27.2	19.2	11.4	7.1	3.9	1.0
2022	0.1	1.3	9.0	26.5	26.8	17.2	9.6	5.7	3.0	0.9
2023	0.0	0.7	5.6	21.3	27.8	20.5	11.7	6.9	4.1	1.5
2024	0.0	0.5	4.0	18.5	29.0	21.8	12.9	7.4	4.4	1.5

7.2 OVERVIEW OF CANDIDATES' PERFORMANCE IN PAPER 1 AND PAPER 2

(a) **Quality of candidates' performance**

It appears that the 2024 cohort of Engineering Graphics and Design candidates performed slightly better than the 2023 cohort in Paper 1; however, the same cannot be said their performance in Paper 2. Consensus among the provinces is that in both papers the questions were of a high standard, fair and consistent with previous year's papers in presentation, language and levels of difficulty.

Each question included elements designed to assess basic skills and knowledge, as well as elements to challenge the top candidates. While the questions pitched at a lower cognitive level were generally well-answered, the performance in the middle and higher cognitive level questions – particularly those covering Grade 12 content – remained poor. Despite this, the performance of candidates who sat for the November 2024 Engineering Graphics and Design examinations showed a slight improvement, compared to the 2023 cohort's performance.

It must be noted that all the questions in both Engineering Graphics and Design papers were designed to be accessible to every candidate. The quality of responses from candidates in centres across all the provinces showed that many candidates were adequately prepared and coped with the complexities and content of this examination. The inability of some of the weaker candidates to effectively deal with the less challenging parts of questions is indicative of the deficiencies within the teaching and learning environment.

A concerning observation was that there were still centres where the majority of candidates performed poorly. This suggests that effective teaching has a direct impact on the performance of candidates.

It is evident that topics specified in the Grade 10 *Curriculum Assessment Policy Statements (CAPS)*, were not given the necessary attention as many candidates did not understand basic concepts, methods and techniques fundamental to EGD. Invariably, this has had an impact on the candidates' performance in the NSC examinations.

(b) **Pertinent factors that cause poor results**:

Poor results in many centres are an indication that challenges in teaching and learning are still prevalent. The following factors continue to be identified as reasons for poor performance:

- **The use of prepared drawing sheets:** Many teachers still make use of prepared drawing sheets for their day-to-day tasks, course drawings, tests and even examinations. As convenient as this practice may be for the teacher, the use of prepared drawing sheets removes the essential practice of the basic skills pertinent to Engineering Graphics and Design and often restricts the candidate's ability to answer certain questions in the examination. The use of **prepared drawing sheets**, with parts of the drawing prepared for the learner, **disadvantages the weaker learner** and this is evident when a learner is unable to construct a simple polygon; or to determine vanishing points; or to position a view correctly on a drawing sheet.
- **Lack of meaningful revision of Grades 10 and 11 content:** All examination questions are based on content that is derived from concepts taught in previous

grades. It is, therefore, essential that the fundamental concepts of every topic are continually reinforced. Teachers must factor these aspects into their teaching, assessment and intervention programmes by ensuring that learners practise even the most fundamental aspects of drawings.

- **Laziness in reading the questions:** An important focus point in Engineering Graphics and Design is the ability to read and understand instructions related to the graphic content used when solving graphic problems. The examination instructions are kept as simple as possible and follow a standard structure, which remains relatively constant from year to year. Many weaker candidates still appear to look at the graphics and assume what the expected response should be by either preparing an incorrect response or running out of drawing space. Some candidates also display poor comprehension skills by providing incomplete responses or responses that do not address the requirements of the question.
- **Language barrier linked with poor comprehension skills:** Some candidates may not have understood the requirements of the questions because of a language barrier, or not knowing the terminology. Learners need to be taught to *read with understanding*. Learners must also be taught the correct terminology used in the subject.
- **Not planning an answer:** When candidates do not read and understand the requirements of a question, they cannot plan an answer. Often candidates rush into answering a question to later discover that they have not left sufficient space on the drawing sheet to place the required views.
- **Lack of formative testing:** Teachers are expected to implement an informal assessment programme to support formal assessment tasks. Short, formative tests must be used to build learner confidence in all topics. Self-marking or peer-marking is an effective tool for providing immediate feedback.
- **Drawing skills:** Engineering Graphics and Design is a knowledge-based subject. However, an essential and unique requirement for the subject is the high level of skill needed to draw quickly, accurately and neatly. Regular practice is necessary for a learner to complete the question paper in the allocated time.

General suggestions to improve results

Limited instruction time in each term necessitates that teachers build the following practices into their *Annual Teaching Plan (ATP)*:

(a) **Prior knowledge:** Every topic should commence by revising the basic concepts and terminology covered in previous years. This would ensure that learners can make connections between old and new knowledge.

(b) **Understanding and planning:** Often poor and incorrect answers result from learners not reading the instructions. Teachers must teach the skill of interpreting and analysing questions using past examination questions. Learners must be encouraged to read instructions carefully and in so doing, understand what needs to be drawn.
This should include:
- Reading each word of the instruction;
- Underlining or highlighting keywords;
- Identifying where the relevant source information can be found;
- Planning the layout of the drawing; and
- Identifying where it would be most appropriate to start an answer.

(c) **Use of textbooks:** A mandatory requirement for all Engineering Graphics and Design learners is a *CAPS* compliant textbook. Teachers have a choice of selecting from a number of DBE-approved textbooks and must stop using prepared drawing sheets.

(d) **Use of past NSC examination papers:** Past question papers serve as one the most important teaching and learning resources available and should be incorporated into the planning and teaching process. Recent past examination papers provide a reliable trend on questioning techniques. Past examination papers, with their marking guidelines, are easily accessible on the Department of Basic Education (DBE) website. Every learner should have this resource readily available to them.

(e) **Time management:** Learners must be trained in time management. This should be applied when preparing course drawings, setting tests and examinations. The mark allocation for a question provides a time guide and learners must practise the skill of working to the time allocations.

(f) **Drawing fitness:** Ongoing and regular practice is essential in developing and maintaining a high level of skill and the ability to draw quickly, accurately and neatly. Preparing a drawing requires the constant manipulation of drawing instruments, which is both tiring and time-consuming. In order to complete an examination paper in the allocated time, learners must be *drawing fit* and this is only achieved through physically drawing and more specifically, drawing within specified time limits.

7.3 ANALYSIS OF CANDIDATES' PERFORMANCE IN EACH QUESTION IN PAPER 1

QUESTION 1: CIVIL ANALYTICAL

Question 1 covered a variety of civil concepts relating to a *site plan*, *civil title panel* and the *SANS 10143 Code of Practice for Building Drawing*. The weaker candidates continue to be challenged by some of the subquestions, while many of the stronger candidates, who had prepared thoroughly for the examination, were able to show insight and understanding and achieved good marks.

The first few questions were generally well answered by most of the candidates. These subquestions were set at a lower cognitive level and at an easy to moderate level of difficulty.

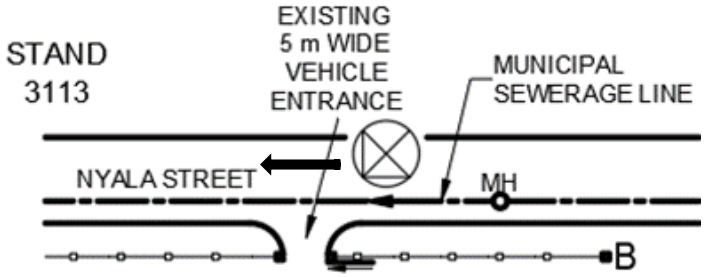
The next set of subquestions, which were set at a middle cognitive level, were less predictable, therefore, slightly more challenging as they required recall and knowledge of the *SANS 10143*. These questions required candidates to study the examinable content.

The last few questions were set at a higher cognitive level and were intended to be the more challenging as they examined the application of the *SANS 10143* content and mathematical concepts in a civil context. Although these questions should have been reasonably predictable, the results suggest that candidates were still unable to solve the more complex problems. It was disappointing to note that previous year's examination papers were not used to prepare for the final examinations.

Common errors and misconceptions

(a) Many candidates were not able to answer questions that related to the *SANS 10143 Code of Practice for Building Drawings,* e.g. Q1.7 identification of the building line; Q1.13 the abbreviation *BIC*; and Q1.14 specifying the colour that must be indicated for new drainage pipes on drainage installation drawings. The necessary information could be found in either the *SANS 10143* or any *DBE*-approved textbook. These questions fell into the middle cognitive range and required the candidate to study examinable content.

(b) Many candidates had a challenge with determining the direction of flow in the municipal sewerage line in relation to the north point, Q1.16. Candidates were not able to apply the concept of the north point on a site plan. Response to this question would only have been possible if they had been taught Grade 12 content and how to apply their knowledge in different contexts.



(c) Very few candidates were able to apply the simplest mathematical skills. It could not be determined whether this was a lack of basic mathematical ability, poor attention to detail or a lack of preparation. This was evident in Q1.15, where the candidates were asked to calculate the shortest distance from the proposed carport to the boundary line in metres; Q1.17, when they were supposed to calculate the total number of guests that can be accommodated at the resort; and Q1.18 and Q1.19, which required the candidates to substitute values into the formula correctly. They failed to divide the given floor plan into manageable sections to calculate the area correctly.

(d) Many candidates were unable to differentiate between *perimeter* and *area*. Questions similar to subquestions Q1.18 and Q1.19 have been asked several times before. Q1.18 required calculating the perimeter of the stand using a basic mathematical calculation of simply adding lengths, which were all given in millimetres. Q1.19 was slightly more challenging, set at a higher cognitive level, and required more mathematical ability. It required the candidate first to divide the drawing of the building into calculable shapes; then the answers had to be added together to determine the total area. Candidates were also **unable** to convert millimetres into metres.

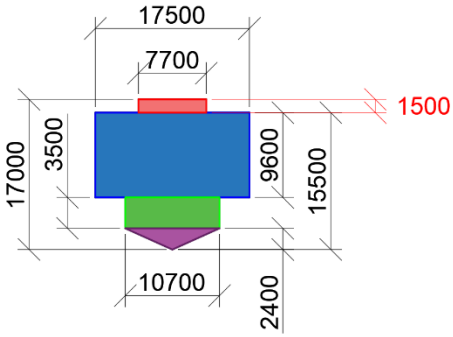
ANSWER 19
Show ALL calculations.
APPLYING CORRECT FORMULA ✓

A = L x B

= (17.5 x 9.6) + (3.5 x 10.7) +
(7.7 x 1.5) + (10.7 x 2.4 / 2)

= 168 + 37.45 + 11.55 + 12.84 ✓ ✓

= 229.84 m² ✓



(e) The presentation of the answers in many scripts was unacceptable. The responses were presented in pen and often illegible. The *SANS 10143* stipulates the type of printing that must be used on drawings. This must be adhered to in all aspects of drawing.

(f) Neatness and proportion are two fundamental requirements to which candidates are expected to adhere when drawing in *neat freehand*. Candidates often overlooked these criteria when preparing freehand drawings. All work in *Engineering Graphics and Design* must be presented neatly. Q1.20 clearly stated that the drawings must be presented in ***neat*** freehand and in a *First-angle Orthographic Projection*. Most

candidates appeared to have disregarded both these instructions, with the freehand line work of candidates being of a poor quality. Candidates must take more care when drawing graphic symbols or conventions.

Suggestions for improvement

(a) Every learner must be in possession of a DBE-approved textbook. Teachers must be in possession of the *SANS 10143 Code of Practice for Building Drawings* and regularly refer to the contents. The civil content must be taught and can be reinforced by periodically giving learners short formative tests which will also serve as useful revision.

(b) Learners acquire knowledge in accordance with how they were taught. It is unfortunate that many teachers appear not to be conversant with the use of the correct terminology in the classroom. The only way that learners will learn the correct technical terms and terminology is if the teacher uses them continually and correctly.

(c) If learners are taught to *read with understanding*, they will be able to comprehend the requirements of a question and then possibly answer appropriately. Learners must be taught how to provide relevant and correct responses to questions. Teachers can assist learners by providing them with a wide variety of questions on civil content, and in particular, past NSC examination papers, with their marking guidelines.

(d) Learners must practise applying the mathematical formulas for determining perimeter and area. Including these calculations in short formative tests can reinforce and revise. Learners should also be taught how to convert millimetres to metres and vice versa.

(e) The quality of a learner's line work is assessed in the practical assessment task (PAT). This does not mean that in an examination freehand work should be presented poorly. There are far too many candidates who present unacceptably untidy and meaningless freehand drawings. All work presented in freehand must be graphically and proportionally correct, meaningful and neat. Printing must also be prepared correctly and neatly. This requires practice and monitoring by their teachers.

(f) Subject advisers should convene regular content workshops with their drawing teachers to help teachers who are experiencing challenges with content and they should offer support where it is required.

QUESTION 2: SOLID GEOMETRY

Overall, Question 2 was poorly answered, compared to previous years. However, there were provinces that reported a slight improvement. The intervention strategies in these provinces appear to be bearing fruit. It has to be determined whether the topic is being taught; or are educators advising their learners not to attempt the question. The more likely scenario is that teachers are using prepared drawing sheets where the polygon is placed and already drawn for the learner, in so doing, depriving the candidate any chance of even attempting the question.

It is important to note that the question was designed to allow the weaker candidate to draw and project three views of the right regular hexagonal pyramid. The slightly more able candidate was expected to place the right square prism in its designated position against the hexagonal pyramid, and the top candidates should have been able draw a sectional top view and a sectional **left** view.

Common errors and misconceptions

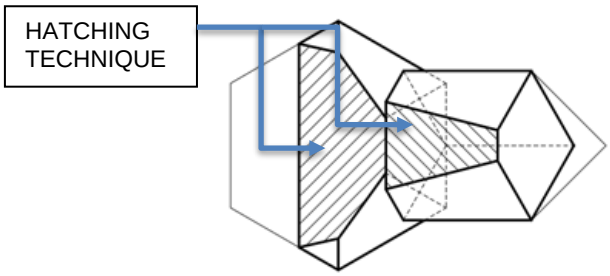
(a) Orthographic projection is a fundamental concept introduced in Grade 10. Many candidates were unable to differentiate between first-angle and third-angle orthographic projection, placing the left view on the incorrect side of the front view.

(b) The order in which a drawing is prepared is an important skill to learn and has to be taught and reinforced regularly. Candidates had difficulty constructing polygons and showed a lack of ability in placing a corner of the hexagon 10 mm in front of the VP.

(c) The correct placement of the views of a drawing on the page is critical. Many candidates failed to plan, resulting in incomplete or misaligned work.

(d) Reading for meaning posed a problem as some candidates omitted include the hidden detail in their response. The question clearly required the candidate to: *Show ALL hidden detail*.

(e) While most of the learners who were able to answer this question managed to complete the front view and top view, it was most unfortunate that many were then unable to project the sectioned **left** view. It must be noted that when hatching the cut surface of different solids, the hatching of the cut surfaces of each solid must be drawn in alternative directions, while the surface of the same solid must then be hatched in the same direction in all the views.



Suggestions for improvement

(a) One of the topics in the Grade 10 *CAPS* (page 8) is first-angle and third-angle orthographic projection. It is not only important that these topics be taught, but there should also be a regular emphasis on their differences

(b) Planning is an essential skill in drawing and takes time to master. As long as teachers insist on giving their learners prepared answer sheets, where learners simply have to produce the required answer, candidates will continue to struggle with planning, in an examination. **The use of prepared answer sheets must be discouraged**. Learners become dependent on them and this affects their ability to respond the demands of the question, as they have not had enough practice in drawing the basic elements.

(c) Understanding the abstract concepts of drawing and projection starts in Grade 10. Drawing and projecting right regular prisms and pyramids are the fundamental building blocks that form the basis of all technical drawing and requires continuous practice and understanding, perception and graphic problem-solving skills. The inability of candidates to construct a Grade 10 polygon reinforces what has been mentioned above. If the teacher uses prepared answer sheets with the basics already drawn for the learner (because it is 'easier' for the teacher), the learner will never get the opportunity to practise constructing the polygon.

(d) The ability to visualise three-dimensional objects drawn on a two-dimensional surface is a challenging concept for many learners. This skill is developed through ongoing and regular practice by preparing drawings of relevant complexity. Adding numbers or letters to the base corners of a polygon is a method that teachers can encourage learners, who have challenges, to use. This will assist learners either in speeding up their drawing or arriving at a solution without necessarily being able to visualise the answer.

(e) Teachers must encourage their learners to read for meaning. In other words, not only must learners read the given instructions, but they should also understand what they have to do.

(f) Subject advisers should identify the underperforming schools, as informed by the analysis of 2024 NSC results, and support the teachers at these schools by providing help on an on-going basis, rather than engaging in damage control prior to an examination.

QUESTION 3: PERSPECTIVE DRAWING

Most of the provinces reported that their candidates showed a slight improvement in answering the perspective question compared to 2023. What is rather disappointing and somewhat concerning is that **all** the issues that were raised over the past few years' diagnostic reports are still the same issues that were found during the marking of this year's examination.

Common errors and misconceptions

(a) Many of the candidates were unable to accurately determine the position of the two vanishing points with the result that whatever was drawn from that point on, was incorrect and had to be *marked with the mistake*. This was the easy, lower cognitive level (Grade 11) part of the drawing. There is no plausible reason for any Grade 12 candidate to experience difficulty in determining the vanishing points and labelling them correctly.

(b) Many candidates moved the position of the given *Horizon Line (HL), Picture Plane (PP)* and/or the *Ground Line (GL).* This demonstrated little, if any, understanding of the purpose of these lines. Moving these lines could possibly alter both the cognitive level and the level of difficulty of the question.

(c) Many candidates were unable to correctly determine height lines or showed little knowledge of the purpose of a height line. Without a height line, the heights of the receding parts of the *house* cannot be determined.

(d) The semi-circular portion of the 'deck' was poorly attempted. Many candidates, who attempted the semi-circular portion, projected the coordinates of the curve inaccurately and the quality of their perspective curves was poor.

(e) Very few candidates managed to draw the dormer window, the part of the question which was pitched at a higher cognitive level. Those candidates who managed to draw the dormer window correctly demonstrated good insight and understanding of the principles of perspective drawing.

(f) It must be emphasised that candidates must read the question thoroughly as many of them failed to include the depth of the wall at the window.

(g) A large number of candidates produce poor quality line work that was inaccurate and untidy. Therefore, it was difficult to assess whether the candidate understood what was supposed to be drawn. All line work must follow the prescripts of the *SANS* where **outlines** are **dark** lines and **construction lines** are **light** lines.

(h) It was clear that teaching the correct perspective method was neglected by the teachers at some centres. It was found that correct perspective drawings were produced by candidates who attended particular schools, and those candidates who showed little to no understanding attended particular schools.

Suggestions for improvement

(a) Determining the vanishing points correctly is fundamental to the preparation of a perspective drawing and is considered to be at the easy lower cognitive level. Teachers must ensure that all learners can perform the basics by teaching the fundamentals of perspective drawing along with the methodology and terminology pertaining to the topic. On-going and regular practice is necessary in developing and maintaining a high level of skill and the ability to draw accurate and neat perspective drawings.

(b) It must be made clear to learners that the position of the given *Horizon Line (HL), Picture Plane (PP)* and *Ground Line (GL)* must **not** be moved. Projection or construction lines are B-type lines and must be visible as they show method. Outlines are A-type lines and must be darker. Learners must also be informed **not** to erase the construction lines as they are important and are used when marking the drawing.

(c) Converting an orthographic drawing into a pictorial drawing is a challenging exercise and even more challenging to teach a learner who has no understanding of how to link the views to create an image. The teacher needs to develop a technique that is easy for the learner to grasp, understand and apply. Alternatively, the teacher must present a method (a set of rules) that can be applied to any perspective drawing.

(d) The height of an object can only be determined in the picture plane. It is, therefore, important for the teacher to reinforce the method of first determining the height of an object in the picture plane (on a height line), then applying the method of moving the object to its correct perspective position by joining it to the correct vanishing point.

(e) Drawing a perspective semicircle is a challenging process which requires in-depth knowledge and skills to project correctly and accurately. It is expected that even the weaker candidates who experience challenges with drawing, should demonstrate some basic knowledge by being able to divide the views of the semi-circle into 30˚ segments.

(f) The complexity of a perspective drawing increases as the drawing is built up by the ever-increasing number of lines used to find the points in perspective. Learners need to be taught to work systematically through the drawing so that they do not waste time determining the same points multiple times (time management).

(g) Teachers need to address poor drawing practices such as inaccuracy, untidiness, incorrect line work as well as poor presentation before they become ingrained. This should start in Grade 10 and continue through to Grade 12.

(h) It is imperative that teachers provide learners with relevant course drawings which are at the level of complexity that is expected of the Grade 12 learner. They should ensure

that the learner engages with these drawings meaningfully. Past examination papers are an excellent resource for perspective drawing exercises.

QUESTION 4: CIVIL ASSEMBLY AND ELECTRICAL LAYOUT

It was encouraging to see that all the provinces reported that the majority of the candidates attempted this question and recorded a slight improvement in the results compared to 2023.

The civil assembly question involves working with complex graphic detail, numeric data and a significant amount of information that requires knowledge and understanding; the ability to *read for meaning* and the application of civil drawing practices as contained in the *SANS 10143 Code of Practice for Building Drawings.*

The answer was divided into three subsections: the floor plan, which is generally made up of lower cognitive level content; the north-west elevation, which was generally middle cognitive level content and a detailed sectional view, which is drawn to a larger scale than the other two views and generally covered the higher cognitive level content. The Grade 12 content in each view yet again proved to be challenging for many candidates, especially the detailed roof components in the detailed section.

Question 4 was designed in such a way that every candidate who practised using past NSC examination papers, should have been able to complete at least part, if not most, of each sub-section.

Many of the weaker candidates appeared to have been either overwhelmed by the question or were not adequately prepared for the examination.

Common errors and misconceptions

(a) FLOOR PLAN

Common errors drawing *windows* and *doors*:

- The doors, in some instances, were not drawn to the correct size or placed incorrectly in the doorframe with the arc of the door swing drawn in freehand. It is important to note that any work presented in freehand without specific instructions informing the candidate that it may be drawn in freehand, IS NOT MARKED.
- Windows were not drawn using the dimensions shown in the window schedule but simply drawn to fill the oversized gap in the wall on *Answer Sheet page 6*. The window sill was omitted by many candidates or drawn more than 1 mm beyond the wall. Window frames (the double line) were often not centred on the wall.

Common errors in drawing *electrical layout*:

- When candidates added the electrical layout to the floor plan, it was often poorly executed which showed a lack of knowledge. The symbols were often haphazardly placed and poorly drawn.
- There was a poor attempt at labelling of the fluorescent light.
- There are still too many candidates who, when drawing the irregular curve connecting the light fitting to the light switch, attached the curve to the 'flag' and not the circle of the switch.
- Some candidates could not identify the correct electrical fitting from the table.

Common errors in drawing *fixtures*:

- Many candidates still draw fixtures as shown in the fixture table rather than converting them to the required *SANS 10143* symbols. The purpose of having a table of fixtures is to inform the candidates of the sizes or measurements of the fixtures.
- The fixtures were not drawn accurately and many candidates did not apply the correct scale ratio to the fixtures.
- Candidates must use drawing instruments to draw the fixtures.

Common *hatching* errors:
There was a general improvement in the quality and correct application of hatching from previous years. There are, however, still many candidates who applied mechanical hatching to the walls and did not clearly show the double parallel lines at 45°, as required.

Common errors with the *labels*:
Many candidates did not add the floor finish to the existing room designation labels. This can be attributed to their not following the instructions which clearly stated what should be done. Labels must always be printed neatly, to the correct size and using the correct font.

(b) NORTH-WEST ELEVATION

Common projecting errors:
- The method of projection from one view to another view is a fundamental drawing technique practised in every lesson from Grade 10. It is alarming that many candidates were unable to project the windows or the doors from the floor plan correctly, in the final examination.
- There were many candidates who could not apply the scale correctly.

Common errors drawing the window and door:
- The height of the windows and doors was often incorrectly determined despite the measurement being placed on the drawing.
- The window opening lines, as well as the window sill, were either omitted or poorly attempted.
- The height of the finished floor level *(FFL)* was not always determined correctly.

Common errors drawing the roof:
- The height of the roof was incorrectly determined by many of the candidates because they could not draw an angle using a protractor. There was a general problem with accuracy in determining the 20° roof angle on the north-west elevation. It must be noted that as accuracy is a fundamental and essential drawing skill: a deviation of only 1° is permissible on any angular measurement in the examination.
- Many candidates did not draw the ridge cover (parallel line) along the edges of the roof where it was required.
- There were many candidates who drew the fascia board and gutter incorrectly. A number of candidates also did not know the meaning of *break lines*. They often just copied them as they were shown in the question. This clearly demonstrated that candidates either did not read the question correctly or that teachers did not prepare the learners adequately for the examination. It is vital that learners have access to past NSC examination papers with the marking guidelines so that this type of elementary mistake is not repeated.

Common errors with the labels:

The printing of the labels applied to the drawing was of a very poor quality.

(c) DETAILED SECTION

- There were fewer candidates who attempted the detailed sectional view, prepared to scale 1 : 20, than those who attempted the other two views. Many of those who attempted this drawing applied the scale correctly.
- The roof detail is Grade 12 content and was not well answered. Many candidates showed very little knowledge of the nine required roof components. Of those candidates who attempted to draw the components, on the detailed section, many of them did not draw all the components accurately or correctly. The most common errors were that candidates either left off components or drew them to the incorrect scale or angle. This is an indication that either the learners were not given sufficient practice drawing roof detail or were not taught how to draw roof detail.
- Many candidates failed to draw from the one given break line to the next, instead drawing short of the line. Any change that the candidate makes to given information may result in a penalty.
- Many candidates drew the lintel correctly but measured the height of the lintel incorrectly and they also showed problems drawing the window sill.
- Most candidates did not draw the door in front of the cutting plane. Those who attempted it made several errors drawing it. The door, placed at an angle, was notably the last part of the sectional view and this part of the question was of a higher cognitive demand. It was designed for the few high-fliers in the country and did not count for many marks.
- Many candidates did not add the DPC and GL labels. Hatching the different components on the sectional view was poorly executed and often not presented according to the *SANS 10143*.

Suggestions for improvement

The basic format of this question has remained relatively constant for a number of years. One of the underlying problems is that this topic is covered very early in the first term. Learners must be given revision drawings, preferably using past *NSC* examination papers, throughout the year. There are many past NSC examination papers that can be used for revision.

(a) FLOOR PLAN

- Weaker candidates must be advised to start Q4 by completing the floor plan and to follow the instructions correctly. Learners must be taught how to the print the required labels correctly taking note that the requirements may change from year to year. They must be taught how to add the electrical layout to a drawing by using the correct fittings and drawing the connections to the circular part of the light switch and not the 'flag'. Learners must also be taught how to draw doors and windows correctly; to the correct size and filling in the hatching detail according to the *SANS 10143*. It must be pointed out that the window frame should be drawn as a set of parallel lines placed in the middle of the wall. The window sill is then a single line that protrudes outwards beyond the wall.
- The tables on the question sheet that contain information should be used correctly. The window and door schedule give the sizes of these features. The correct electrical symbol must be selected from the table and correctly copied across onto the drawing. The candidate must have access to and learn the *SANS 10143* graphical symbol for the fixtures and apply them using the dimensions given in the table. The orientation of the text on the *incomplete floor plan* indicates the positioning and placement of the fixture. Hatching must be added using drawing instruments and should not be done freehand.

(b) NORTH-WEST ELEVATION

- To prepare an elevation, there are three general areas on which the teacher needs to concentrate. These are: the basic method of projection, drawing the roof and accuracy.
- Projecting requires selecting the necessary information off the floor plan and projecting it to the elevation.
- The **projection** of the roof off the floor plan is a Grade 12 topic and can be challenging for the learner who was not taught how to draw the roof with all the rain-water components. Once the detail and the method have been taught, the learner must practise projecting the roof.

(c) DETAILED SECTION

- The **detail** of a roof is Grade 12 content. Learners must be taught the order in which the roof components appear, then practise drawing them correctly and accurately.
- The same applies to the *SANS* hatching patterns used to differentiate the various elements in the sectional elevation.
- Learners must be taught how to take measurements off the floor plan or elevation and to convert them to measurements that can be used in the detailed drawing.

(d) Teachers should have an ample supply of resource material to give the learners to prepare for this topic. The minimum requirements must be a copy of the *SANS 10143 Code of Practice for Building Drawings*, a DBE-approved textbook and past NSC examination papers.

(e) It is imperative that course drawings are set at an appropriate level so that learners can engage meaningfully with work that is at the required level.

(f) All drawings must be prepared using drawing instruments and learners are expected to be skilled in using them correctly. It must be noted that any work presented in freehand unless specified in the question, is not marked, even if correct.

(g) Learners should not be expected to sit for an examination without being taught time management. Teachers should set course drawings that must be completed within specified time constraints.

(h) It is important that concepts taught in previous grades and terminology pertaining to a topic must be briefly revised prior to the introduction of a new topic. This should enable learners to make connections between old and new knowledge. If learners master the basics, they will be able to grasp the more challenging concepts.

(i) Adding labels to a drawing is regarded as a lower cognitive exercise so when candidates do not add the labels it strongly suggests that the candidate did not read the instructions. Many candidates also assigned labels to unnecessary features.

(j) Subject advisers must address the issue of *language across the curriculum* by providing opportunities for teacher development on an on-going basis.

7.4 ANALYSIS OF CANDIDATES' PERFORMANCE IN EACH QUESTIONS IN PAPER 2

It appears that the 2024 cohort of candidates did not perform as well in Paper 2 as their peers had done in 2023. It was also pointed out by most provinces that Paper 2 was written in week four of the examinations and after a 2½ hour English literature paper. However, the final

timetable was released months before the start of the examinations giving both teachers and learners adequate time for planning and preparation. Insofar as scheduling two long and challenging papers, one after the other on the same day sounds academically unsound, it is not a valid argument for learner underperformance and should not be used in mitigation. It is the teacher's responsibility to prepare learners for all eventualities, as difficult as this may be.

It was found that all the questions in Paper 2 were fair and error-free. Most candidates managed to complete the paper in the allotted time allocation and a number of them achieved very good marks.

QUESTION 1: MECHANICAL ANALYTICAL

Question 1 covered a variety of mechanical concepts relating to *mechanical parts, an assembly, a mechanical title block* and the *SANS 10111 Code of Practice for Engineering Drawing*. The weaker candidates continue to be challenged by some of the subquestions, while many of the stronger candidates, who had prepared, were able to show insight and understanding and achieved good marks.

The first few subquestions were set at an easy to moderate level of difficulty, at the lower cognitive level. These questions were successfully attempted by the majority of candidates.

The middle set of subquestions were less predictable and, therefore, a little more challenging as they required the recall of knowledge of the *SANS 10111 Code of Practice for Engineering Drawing.* These questions were set at a middle cognitive level and proved to be more of a challenge.

The last few questions were the most challenging as they examined the application of the *SANS 10111 Code of Practice for Engineering Drawing* and content with mathematical concepts, in a mechanical context. These were set at a higher cognitive level. Although these questions were reasonably predictable, candidates' responses remained disappointing.

Candidates did not perform as well in Q1 as they did in 2023 resulting a slight decline in results. There were still far too many candidates who displayed a lack of knowledge in areas which suggested that either they were not prepared to sit for the examination or they may not have had a suitably qualified teacher to guide them through the work.

All the questions covered a variety of mechanical concepts – the weaker candidates continued to be challenged by these topics. The more capable candidates were able to show insight and understanding and they achieved good marks.

Common errors and misconceptions

(a) A matter of concern is the large number of the candidates who displayed poor reading and comprehension skills when answering the subquestions. Many of the candidates submitted responses that had no relevance or bearing on the question being asked.

(b) A number of the subquestions came directly from the *SANS 10111*, and covered concepts that are generally used in most aspects of the mechanical drawing. The questions were: Q1.5, Q1.10, Q1.11, and Q1.12. Q1.14, Q1.15 and Q1.20 These questions range from easy lower cognitive level questions to difficult higher cognitive level questions. Many of the candidates displayed little, if any, knowledge of the contents of the *SANS 10111.*

(c) In Q1.17 many candidates failed to correctly calculate the minimum or the maximum tolerance of the dimension at *F*. This could be ascribed to either one, or a combination, of the following reasons: poor comprehension of the question; limited knowledge of both the terminology and the topic or inability to solve mathematical problems.

(d) Many candidates could not recall Grade 10 work by preparing a geometric construction Q1.18. What is concerning is that the construction is used in both mechanical and civil technology subjects. It should also have been taught in mathematics, yet candidates found it challenging.

(e) Very few candidates managed to correctly draw and place the given information and processes on a machining symbol Q1.19. This information can be found in either the *SANS 10111* or any *DBE*-approved textbook.

Suggestions for improvement

(a) Teachers must address the issue of *language across the curriculum* by teaching learners to *read for meaning* which will help them to understand and apply terminology correctly. Teachers must make use of past NSC examination papers as a resource that would benefit every learner by teaching them the terminology used in a drawing and the way in which questions are phrased.

(b) Calculating a tolerance is a simple mathematical process that has been asked before. Learners must be taught how to identify and apply a tolerance to a dimension and particularly the mathematical process of determining a tolerance. They then need to practise the concept by applying it to a number of dimensions.

(c) It is essential that every drawing teacher has a copy of the *SANS 10111 Code of Practice for Engineering Drawings* in their classroom as the content is fundamental to the teaching of engineering (mechanical) drawing. It is also essential that every learner has a DBE-approved textbook.

(d) Engineering Graphics and Design is both a knowledge and a skills-based subject. Therefore, analytical exercises should be provided regularly, so that learners can learn how to *read with understanding* and become familiar with technical terms. They also need to be taught how to interpret and answer analytical questions.

(e) To balance the predictable nature of this question, examiners will always strive to be creative, within reason, when designing subquestions. Teachers can assist learners by providing them with a wide variety of questions on mechanical content, and in particular past *NSC* examination papers with marking guidelines.

(e) Subject advisers or subject coordinators should convene regular content workshops to help the teachers who are experiencing challenges with content and offer support where it is required.

QUESTION 2: LOCI

Most of the candidates appeared to have found the mechanism, and to a lesser extent, the displacement graph of a cam, challenging with the result that the question was not answered as well in 2024 as it was in 2023.

The concerning trend that persists is that there are still far too many centres, in every province, where candidates experienced challenges.

Common errors and misconceptions

2.1 THE MECHANISM

(a) Many candidates did not even manage to copy the given schematic diagram correctly which required no reading nor understanding but they simply had to copy the given information accurately. They were unable to apply lines correctly; their line work was untidy and unacceptable and they were unable to subtract 60 mm from 120 mm.

(b) Those candidates who managed to draw the schematic diagram correctly appeared not to have understood how to determine the locus of the point B. It is uncertain whether this was a reading issue, a lack of understanding or a problem with the method of teaching. The cause can only be ascertained once all the variables have been tested.

(c) The word *oscillate* has been used in previous examination papers and as recently as 2023. Should the candidate not have understood the word *oscillate* then a rudimentary understanding of a mechanism or simply by looking at the schematic diagram, should have provided a reasonable explanation.

(d) A concerning trend was the number of candidates who divided the circle into 8 segments, not the standard 12. They then failed to show the required construction needed to determine the loci.

2.2 THE CAM

(a) Despite presenting the displacement graph in a slightly different format, more candidates attempted Q2.2 than the mechanism Q2.1, with many of them achieving good marks.

(b) Far too many candidates still have challenges when it comes to the construction needed to determine the *uniform acceleration and retardation* movement and could not divide the horizontal and vertical axes on the displacement graph into the same number of divisions as is required. What is more concerning is that after asking similar questions in the past, candidates still confused *uniform acceleration and retardation movement* with *simple harmonic motion.*

(c) Most of the candidates did **not** read the instructions carefully which was evident by many of them not labelling the displacement graph – the easy lower cognitive level addition to the question.

(d) In many instances, the line work was exceptionally poor. Candidates displayed no differentiation in the application of the line types including poor quality curves.

(e) Again there were centres in each province where the candidates performed well and many centres in every province where the candidates experienced challenges and showed a lack of knowledge.

Suggestions for improvement

2.1 THE MECHANISM

(a) All the topics in the *CAPS* must be taught. If the *ATP* is adhered to then there should be enough time to complete every topic. Ongoing and regular practice of the basic concepts is essential in developing and maintaining a high level of skill and ability.

(b) Understanding the movement of a mechanism is crucial to being able to determine the locus of a point on the mechanism. There are many commonalities between the various types of mechanisms and if these are explained to the learners, they should be less overwhelmed when they have to determine the movement of a point on a mechanism that they may not have seen before.

(c) Teachers must explain the terminology that describes the movement of a mechanism to the learners in order for them to understand what is happening at each point during the movement. It is essential to use past examination papers to assist learning and teaching.

(d) Candidates must be instructed **not** to erase the construction they use as it shows the method that was used to determine the answer. They should also be taught the correct use of line types as drawing is a universal language, and the line type used informs the person reading the drawing of its intention.

(e) Teachers must stop using **prepared answer sheets. T**his affects their learners' ability to respond the demands of the question, as they have not had enough practice in drawing the basic elements.

2.2 THE CAM

(a) Only if a learner is familiar with a topic will they be able to address that topic in an unfamiliar format. This can be easily overcome by teachers using past NSC examination papers as a foundation for both their lessons and as revision.

(b) There are three motions of a follower that must be taught at school. These are: *uniform motion, simple harmonic motion* and *uniform acceleration and retardation*. These have to be carefully explained to learners and then practised. The more practice the learners are able to get, the less the chances are that they will make unnecessary mistakes under examination conditions.

(c) Learners acquire knowledge according to the way they were taught and it is unfortunate that many teachers appear not to be conversant with, nor use, the correct terminology in the classroom. The only way that learners learn the correct technical terms and terminology is when the teacher uses them correctly and continually. If learners are taught to *read for meaning*, it will help them understand the requirements of a question.

(d) Construction lines are lighter than outlines and must **not** be erased. These guide the marker on the possible method that the candidate used to determine the answer. Marks are often allocated for showing method.

(e) Subject advisers or subject coordinators should convene regular content workshops to help the teachers who are experiencing challenges with content and offer support to them, where it is required.

QUESTION 3: ISOMETRIC DRAWING

Converting an orthographic drawing into an isometric drawing remains one of the more challenging topics in drawing. Most of the candidates attempted the isometric drawing with a large number of them obtaining satisfactory results. There are still some areas of concern.

Common errors and misconceptions

(a) Many candidates showed a lack of skill and ability when they had to convert the 2-dimensional (third-angle orthographic) drawing into a pictorial (isometric) drawing.

(b) Many candidates could not construct a pentagon, a basic Grade 10 construction.

(c) Many candidates did not draw nor show the auxiliary view of the pentagon or the 60º angle – both essential for determining the non-isometric lines. Some candidates who realised that auxiliary views had to be drawn, then had challenges transferring the dimensions from the auxiliary view to the isometric drawing correctly and accurately.

(d) Constructing an isometric arc still appeared to be a challenge to many candidates. A number of those who managed to construct the isometric arc correctly did not include the mandatory centre lines.

(e) Many candidates demonstrated poor drawing skills as they drew inaccurately. In many instances, the line work was untidy and of poor quality. Some candidates completed the isometric drawing in construction lines only, and did not use the mandatory A-type lines.

Suggestions for improvement

(a) The inability of candidates to produce fundamental Grade 10 work which should have been revised and applied in Grades 11 and 12 is worrisome and needs to be addressed urgently. Teachers must stop using prepared answer sheets with pre-drawn polygons and views that have been set out for the learner. The inability of a learner to produce fundamental Grade 10 work is the consequence of this practice.

(b) Acquiring the skill to prepare an isometric drawing requires a lot of practice. The practice revolves mainly around developing the ability to convert a 2-dimensional, third-angle orthographic drawing into an isometric drawing by linking the features in each view and placing them correctly on the drawing. This skill has to be practised regularly as many learners find it challenging. As challenging as this topic may be, the more practice learners get, the more capable they should become in visualising a feature of the object in the various views and placing it in its correct position on the isometric drawing.

(c) Learners need to be taught that angled lines, or non-isometric lines generally cannot be added to an isometric drawing without first drawing them as a flat auxiliary view. After drawing a box around the angled line on the auxiliary view, the box can then be transferred to the isometric drawing and the angled line added. This method requires practice.

(d) Constructing an isometric circle or arc is a Grade 11 concept. Any method that requires the learner to use a compass to draw the ellipse may be used. Freehand curves are unacceptable and are not marked. Learners must remember to draw centre lines in circular objects.

(e) Accuracy is a fundamental and essential skill in drawing. This is especially so in isometric drawing in order to get the different features on the drawing to align. Drawing equipment, if used regularly, it needs to be replaced when the numbers and divisions become faded to the extent that they can no longer be seen.

(f) It is imperative that the teacher provides learners with a suitable number of relevant isometric course drawings from Grade 10 through to Grade 12 and at the expected level of complexity. It is important that Grade 12 learners engage with the work meaningfully, in order to fully prepare themselves for the examination. Teachers can assist learners by providing them with a wide variety of examples to expose them to as many different isometric questions as possible, and especially making use of past NSC examination papers, with marking guidelines.

QUESTION 4: MECHANICAL ASSEMBLY

It appears that Question 4 was answered more satisfactorily in this examination than the other three questions. There were still too many weaker candidates who appear to have become overwhelmed with processing all the graphic and numeric information and who found this question very challenging.

A mechanical assembly drawing required the candidate to develop an understanding of the interrelationship between graphic information and numeric data and the application of mechanical drawing practices, as contained in the *SANS 10111 Code of Practice for Engineering Drawings.* It also included the ability to follow instructions.

The question was designed in such a way that candidates who had prepared themselves through adequate practice and had used previous NSC examination papers, should have had access to at least part of each subsection.

Common errors and misconceptions

(a) The overall performance of the candidates who attempted this question was below average. Some candidates completed both the required views while the majority only managed one view. The reason for this is unclear as it could be attributed to one or more of the following: poor time management; not reading the question with understanding; a lack of practice or not being drawing fit.

(b) Candidates showed little understanding of third-angle orthographic projection through either placing the required views in the incorrect position or drawing the views by looking at them from the wrong direction.

(c) Many candidates showed little to no understanding of the rules of sectioning which are comprehensively covered in the *SANS 10111 Code of Practice for Engineering Drawings* and all the DBE-approved textbooks.

(d) The construction of the M16 hexagonal nut was particularly poorly executed. There were too many candidates who showed little to no knowledge of how to construct the required three faces of a hexagonal nut.

(e) There was a high number of candidates who simply redrew the individual parts of the assembly without assembling them, and were heavily penalised for this. When candidates do not apply the concept of assembling mechanical parts correctly, they alter the cognitive level of the question significantly and undermine the essence of the question.

(f) There were unnecessary but general mistakes made by many candidates. These included omitting centre lines, which should have been copied across from the *parts sheet*, and poor planning. Many candidates did not read nor understand what a half-section was and drew the front view as a full section.

(g) The presentation of the candidates' line work was well below the expected standard of competency and skill. Many candidates applied inaccurate measurements which compounded their challenges.

Suggestions for improvement

(a) Teachers must have an ample supply of resource material to prepare for this topic. The minimum requirements would be a copy of the *SANS 10111 Code of Practice for Engineering Drawings*, a DBE-approved textbook and past NSC examination papers. Course drawings must be set at an appropriate level so that learners can engage with the work, comprehensively and at the required level. One of the underlying problems with mechanical assemblies is that it is covered very early in the year. Therefore, it is essential for learners to be given regular revision drawings throughout the year to prepare them for the end-of-year examinations.

(b) Orthographic projection is a fundamental concept that is introduced in the Grade 10 year. Many candidates were unable to differentiate between first-angle and third-angle orthographic projection, incorrectly placing the views or viewing them from the wrong direction. It remains unclear as to whether this was a reading problem, a planning problem or whether the learners lacked an understanding of the concept. Point 3 under *Instructions and Information* on the cover page of the examination paper states that: *ALL drawings are in third-angle orthographic projection.*

(c) The rules of hatching used to differentiate the various parts in a sectional view are contained in the *SANS 10111* and all DBE-approved textbooks. The rules of hatching, along with the various types of sectioning, must be addressed.

(d) The construction of a hexagonal fastener is a Grade 11 topic as mentioned on page 21 of the *CAPS*. It really is unacceptable that there are so many candidates at the end of their Grade 12 year who are still unable to construct hexagonal fasteners. They appear in every mechanical assembly drawing, in every DBE-approved textbook and in every past NSC examination paper.

(e) It must be made clear to those teachers who are telling their weaker learners to simply redraw the individual parts of Q4, that there is a heavy penalty imposed on candidates who are unable to assemble the parts. These candidates are only showing an easy lower cognitive level functioning. Learners must be taught how to read the information given to them on the exploded isometric drawing, which shows the position of each part of the assembly, relative to all the others. The intention of the exploded isometric drawing is to help the candidate to visualise both the general shape of the parts, and the sequencing of the parts in the assembly.

(f) Accuracy has to be mentioned again as it is a fundamental aspect when preparing drawings. A tolerance of only 1 mm is allowed when marking a drawing. Learners must be informed of the necessity to work accurately. All drawings must be prepared using drawing instruments and learners are expected to be skilled at using them correctly. It must be noted that any work presented in freehand, unless specified in the question, is not marked, even if correct.

(g) Learners should not be expected to sit for an examination without being taught time management. This concept can only be realised by setting course drawings that must be completed within specified time constraints.

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