

## CHAPTER 5

### MECHANICAL TECHNOLOGY

#### 5.1 AUTOMOTIVE

The following report should be read in conjunction with the Automotive question paper of the November 2018 examinations.

##### 5.1.1 PERFORMANCE TRENDS (2018)

In 2018, 2 986 candidates sat for the Automotive examination. This was the first examination in which the specialisation subjects were examined. The candidates performed well with 2 814 candidates, i.e. 92,4% of the cohort, passing at the 30% level and above.

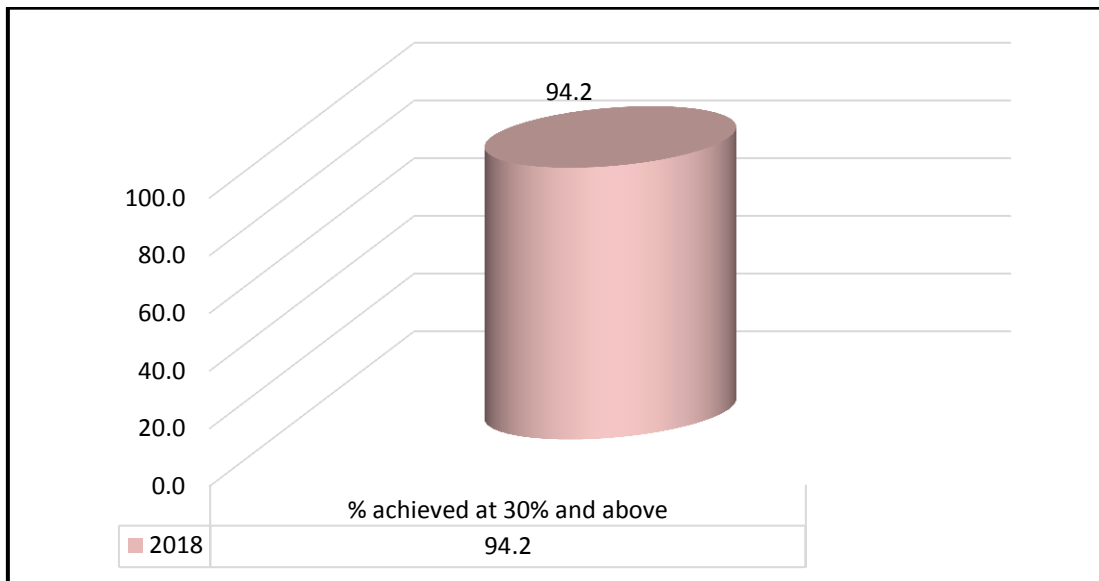
The results may improve in future, with stability in the curriculum and with teachers and learners becoming familiar with the assessment style of the subject.

**Table 5.1.1(a) Overall Achievement Rates in Automotive**

Year	No. Wrote	No. achieved at 30% and above	% achieved at 30% and above
2018	2 986	2 814	94,2

There is still room for improvement in the performance of the learners if the challenges surrounding problem-solving skills, mathematical skills, conceptual understanding and integration of topics are addressed. In this regard, integrated problem solving must become an integral part of teaching and learning.

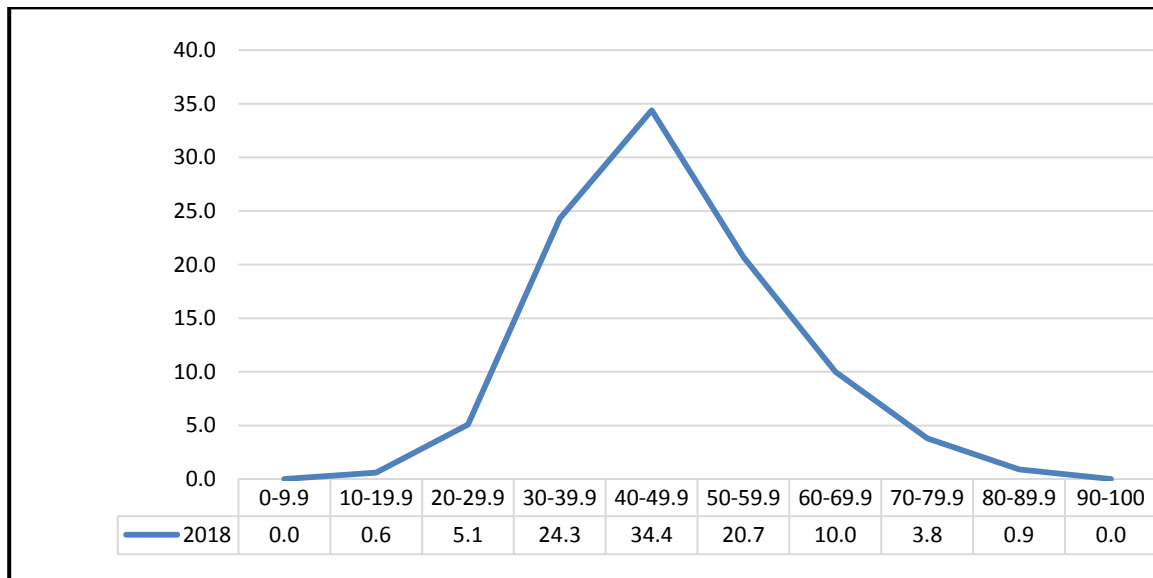
**Graph 5.1.1(b) Overall Achievement Rates in Automotive (Percentage)**



**Table 5.1.1(c) Performance Distribution in Automotive (Percentage)**

Year	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
2018	0,0	0,6	5,1	24,3	34,4	20,7	10,0	3,8	0,9	0,0

**Graph 5.1.1(d) Performance Distribution Curve in Automotive (Percentage)**



Graph 5.1.1(d) indicates the following performance distribution:

- 5,7% of candidates did not meet the pass requirement of 30%
- 94,3% of candidates met the pass requirement over 30%
- 4,7% of candidates achieved over 70%
- 0,9% of candidates achieved at the highest performance level over 80%.

## 5.1.2 OVERVIEW OF LEARNER PERFORMANCE IN PAPER

### General Comments

- (a) Questions pertaining to pure recall of content were very poorly answered. Teachers are advised to use short informal assessment tasks to reinforce basic concepts and principles. This can be used to good effect in content relating to definitions, functions, labelling and operations listed in the CAPS and the examination guidelines.
- (b) Some candidates cannot apply formulae correctly. Teachers should emphasise the use of the relevant formula provided on the formula sheet, correct substitution and providing the answer with the correct unit and direction in terms of requirements of questions.
- (c) The application of mathematical principles is a challenge for many candidates. Learners should be given a variety of problem-solving activities that involve mathematical knowledge pertaining to the manipulation of formulae and the application of trigonometry in classwork, homework, tests and examinations.
- (d) Candidates' handwriting should not be too small and calculations should not be cramped onto one section of the page.
- (e) Learners need to be taught language skills in order to distinguish between terms such as 'before', 'during', 'while' and 'after'.
- (f) Candidates do not appear to read questions carefully and consequently do not answer certain subquestions.
- (g) Candidates revealed a lack of knowledge or exposure to the use of various tools and equipment.
- (h) Teachers seem to focus more on calculations than on theoretical concepts.
- (i) Teachers should use previous papers as support material and as exercises in the classroom especially when training learners to answer multiple-choice questions.
- (j) Worksheets and regular informal assessment, e.g. class tests, will benefit learners.
- (k) Teachers are advised to use resources, such as video clips, charts, PowerPoint presentations and additional textbooks, to illustrate the relationship between content and real-life situations.
- (l) Theory and practical tasks should be integrated in teaching and learning.
- (m) Integration of content from other subjects, such as Mathematics, Technical Mathematics, Physical Sciences, Technical Sciences and Engineering Graphics and Design will benefit learners.

- (n) Teachers and subject advisors should develop an item bank of questions and answers for the subject including factual content, calculations and drawings.
- (o) Moderation by SMTs and/or PEDs will serve to ensure that the curriculum is covered on time.
- (p) Teacher training needs to focus on setting of papers according to cognitive levels (tests and examination). Sufficient resources are available for this purpose.
- (q) Teacher training should focus on content knowledge in addition to practical training.
- (r) Schools need to adhere to the notional time when setting timetables. Double periods should be allocated for practical task.
- (s) Schools and the PED need to support teachers with resources. It became clear in the responses from the learners that they have no idea of what some of the tools and equipment look like because they are not available in the workshops at school.

### **5.1.3 ANALYSIS OF LEARNER PERFORMANCE IN EACH QUESTION IN AUTOMOTIVE (GENERIC)**

#### **SECTION A (GENERIC)**

#### **QUESTION 1: MULTIPLE-CHOICE QUESTIONS**

##### **Common Errors and Misconceptions**

- (a) In Q1.4 candidates could not identify the correct properties of materials.
- (b) In Q1.5 candidates could not identify the outcome of a sound.

##### **Suggestions for Improvement**

- (a) Teachers must provide worksheets to identify the different properties of materials to illustrate practical demonstrations in the workshop.
- (b) Learners should be exposed to informal assessment to master the content.
- (c) Teachers should conduct practical demonstration of a sound test and explain the outcome to the learners.

## **QUESTION 2: SAFETY (GENERIC)**

### **Common Errors and Misconceptions**

- (a) In Q2.1 candidates confused the safety measures of the angle grinder and bench grinder, revealing a lack of content knowledge of this topic.
- (b) In Q2.2 candidates could not state the correct reasons relating to welding goggles during the oxyacetylene welding process.
- (c) In Q2.5 candidates could not state the responsibility of the employer when applying first aid in the workplace; instead they provided first-aid items.

### **Suggestions for Improvement**

- (a) Teachers must conduct practical demonstrations on the two-angle grinder and bench grinder to illustrate in-depth and different safety measures for each tool.
- (b) Teachers must conduct practical demonstrations of the use of different safety equipment when using oxyacetylene and arc welding apparatus.
- (c) Teachers are advised to provide worksheets indicating the difference between applying and providing first aid in the workplace.

## **QUESTION 3: MATERIALS (GENERIC)**

### **Common Errors and Misconceptions**

In Q3.4 candidates did not provide the factors of heat treatment, they explained the hardening process instead.

### **Suggestions for Improvement**

Teachers should provide worksheets to differentiate between the factors required for heat treatment and the hardening process. Theory and practice should be integrated to enhance content knowledge.

#### **5.1.4 ANALYSIS OF LEARNER PERFORMANCE IN EACH QUESTION IN AUTOMOTIVE (SPECIFIC)**

##### **QUESTION 4: MULTIPLE CHOICE (SPECIFIC)**

##### **Common Errors and Misconceptions**

- (a) In Q4.3 candidates could not differentiate between the types of superchargers.
- (b) Common errors in Q4.4 were in respect of the function of the vibration damper.
- (c) In Q4.8 candidates confused the transmission control unit with the electronic control unit.
- (d) In Q4.12 the function of the static balance of the tyre assembly was poorly answered.

##### **Suggestions for Improvement**

- (a) Teachers should use video clips to differentiate between different types of superchargers and turbochargers relating to the labels and working principles. Textbooks of Senior Motor Mechanics should also be utilised as another resource since it is more detailed than the new textbook for Automotive.
- (b) Learners should be exposed to the vibration damper when demonstrating the practical principle of operation and explaining the purpose of each component.
- (c) Learners should be given worksheets on automatic transmission so that they can master the functions and concepts.
- (d) A practical demonstration should be done using the wheel balancing machine. If equipment is unavailable, learners can be taken to an industrial site for practical experience to develop a better understanding of the function of and reasons for wheel balancing.

## **QUESTION 5: TOOLS AND EQUIPMENT**

### **Common Errors and Misconceptions**

- (a) In Q5.1.2 candidates were unable to label the parts of a compression tester.
- (b) Q5.2 was poorly answered because learners could not differentiate between the cylinder leakage tester and the compression tester.
- (c) In Q5.3 candidates did not interpret the question correctly. They responded with a general answer on the toxicity of the exhaust gases in the environment.
- (d) In Q5.5 candidates could not theoretically explain the practical knowledge to check the chamber using the bubble gauge.
- (e) In Q5.6 candidates could not state the faults that can be established when performing dynamic wheel balance.

### **Suggestions for Improvement**

- (a) Learners should be exposed to the use of tools and equipment and their purpose during teaching and learning in the workshops.
- (b) Learners must be given worksheets containing various pictures of tools to name, identify and state the functions of the compression tester and cylinder leakage tester.
- (c) Teachers need to apply certain methods which will be used in such a way that the theory lesson will be related to practical work in the workshop. This is to ensure that learners are able to better understand what gases are being analysed.
- (d) Teachers should also provide more practical activities so that learners can master the checking of the chamber using the bubble gauge.
- (e) Practical skills in performing dynamic wheel balance must be incorporated when teaching this content and teachers need specialized training in the specialized tools and equipment.

## **QUESTION 6: ENGINES (SPECIFIC)**

### **Common Errors and Misconceptions**

- (a) In Q6.3 candidates could not explain the procedure to determine the firing order of an engine.
- (b) In Q6.4 learners could not differentiate between the firing order of an in-line engine and that of a V-engine.
- (c) In Q6.5 candidates could not label the components of the turbocharger due to lack of exposure to the turbocharger.
- (d) In Q6.6 candidates could not define turbocharger terminology of boost and turbo lag.
- (e) In Q6.7 candidates demonstrated a lack of content knowledge regarding the function of the waste gate in a turbo charger. The general response provided was 'to release exhaust gases' instead of 'diverting some of the exhaust gas'.

### **Suggestions for Improvement**

- (a) The topic of the turbocharger must be done thoroughly at school so that learners can identify between the component labelling, terms and purpose of the turbocharger.
- (b) Teachers need to bring this to the attention of learners when teaching firing order to emphasize that there is a distinct difference between the firing order of a V-type engine and the firing order of an in-line engine. In addition, video-clips from YouTube and charts can be used to integrate theory with practical tasks in the workshop.
- (c) Teachers should design a worksheet to cater for labelling, functions, operation, advantages and disadvantages of a turbocharger to enhance understanding of the turbocharger.
- (d) Learners must be given a glossary of content terminology to study and should be exposed regularly to it in informal assessment or homework activities.



- (e) Practical demonstrations should be used to ensure better understanding of the function of the waste gate.

## **QUESTION 7: FORCES (SPECIFIC)**

### **Common Errors and Misconceptions**

- (a) In Q7.1 and Q7.2 candidates could not define torque and clearance volume.
- (b) In Q7.4 candidates were unable to manipulate the formulae to match the required calculations for the compression ratio.
- (c) In Q7.5 candidates could not convert standard units to the required units. Many learners are challenged with mathematical concepts which are essential bases to such calculations.

### **Suggestions for Improvement**

- (a) Teachers are advised to design a worksheet to cater for term definitions in respect of torque and terminologies involving forces, such as compression ratio, brake power and mechanical efficiency.
- (b) Manipulation of formulae forms the basis of calculation in the subject. Learners must be assisted to acquire this skill. Teachers should provide more calculation activities using previous examples from question papers and various textbooks.
- (c) Teachers must give assessment activities on the formulae and the conversion of standard units frequently. This should be emphasized at regular intervals and learners must know how to manipulate the formulae to match the questions.

## **QUESTION 8: MAINTENANCE (SPECIFIC)**

### **Common Errors and Misconceptions**

- (a) In Q8.2 candidates did not state the percentage of the manufacturer's specification to conduct a gas analysing test.

- (b) In Q8.3 and Q8.4 candidates' responses indicated a lack of practical knowledge regarding the results and causes for a cylinder leakage test.
- (c) In Q8.5 candidates could not write the procedure to conduct a compression test in the correct sequence.
- (d) In Q8.7 candidates did not explain, in point form, the pressure testing of the cooling system.

### **Suggestions for Improvement**

- (a) Teachers must show learners how to interpret manufacturer's specification manuals and to apply them correctly.
- (b) Teachers will need to conduct the cylinder leakage test practically and allow learners to complete a worksheet covering results and causes of the tests. Teachers should also use video clips related to the cylinder leakage test to enhance learners' knowledge.
- (c) Teachers must do a practical demonstration to explain the correct sequence for conducting a compression test; learners must be taught how to write this theoretically, in the correct sequence.
- (d) Teachers must do a practical demonstration and explain, in point form, how to perform a pressure test of the cooling system. This can also be emphasised through the use of video clips from YouTube.

## **QUESTION 9: SYSTEMS AND CONTROL (AUTOMATIC GEARBOX) (SPECIFIC)**

### **Common Errors and Misconceptions**

- (a) In Q9.1 candidates could not differentiate between an automatic transmission and a manual gearbox.
- (b) In Q9.3 .1 candidates omitted relevant information when stating the functions of the torque converter.
- (c) In Q9.3.2 many candidates were unable to label the parts of the torque convertor.
- (d) In Q9.4 and Q9.5 candidates did not state the types of gear ratio and the function of the gear ratios respectively.

### **Suggestions for Improvement**

- (a) Teachers should use live models and vehicles to show the different drive methods between the Automatic transmission and manual Gearbox.

- (b) The content could be taught well by using a variety of media such as videos, PowerPoint presentations and simulations to make learners conversant with the torque converter.
- (c) Teachers should use labelled charts and displays on walls for learners to see the labels. Notes should be given to learners to assist them in completing worksheets.
- (d) Teachers need to demonstrate the operation of an epicyclic gear system separately from the gearbox and this can be well demonstrated using video clips.

## **QUESTION 10: SYSTEMS AND CONTROL (AXLES, STEERING GEOMETRY AND ELECTRONICS)**

### **Common Errors and Misconceptions**

- (a) In Q10.1 candidates could not differentiate between the pre-checks for wheel alignment and wheel balancing.
- (b) In Q10.2.1 candidates could not identify the correct wheel alignment angle, whether it was positive or negative, and the correct labelling thereof.
- (c) In Q10.5 candidates could not differentiate between the chemical process and the function of the catalytic converter.

### **Suggestions for Improvement**

- (a) Teachers must do the practical application of wheel alignment so that learners can answer the questions correctly.
- (b) Teachers should also use video clips related to the alignment angles to be dealt with, as well as worksheets for labelling.
- (c) During school-based assessment, learners should be exposed to this type of question which differentiates between the chemical process and the function of the catalytic converter.

## 5.2 FITTING AND MACHINING

The following report should be read in conjunction with the Fitting and Machining question paper of the November 2018 examinations.

### 5.2.1 PERFORMANCE TRENDS (2018)

In 2018, 2 088 candidates sat for the Fitting and Machining examination. This was the first examination of the specialisation subjects. The performance of the candidates in 2018 reflects a good achievement with 1 922 candidates, i.e. 95,4% of the cohort, passing at the 30% level and above.

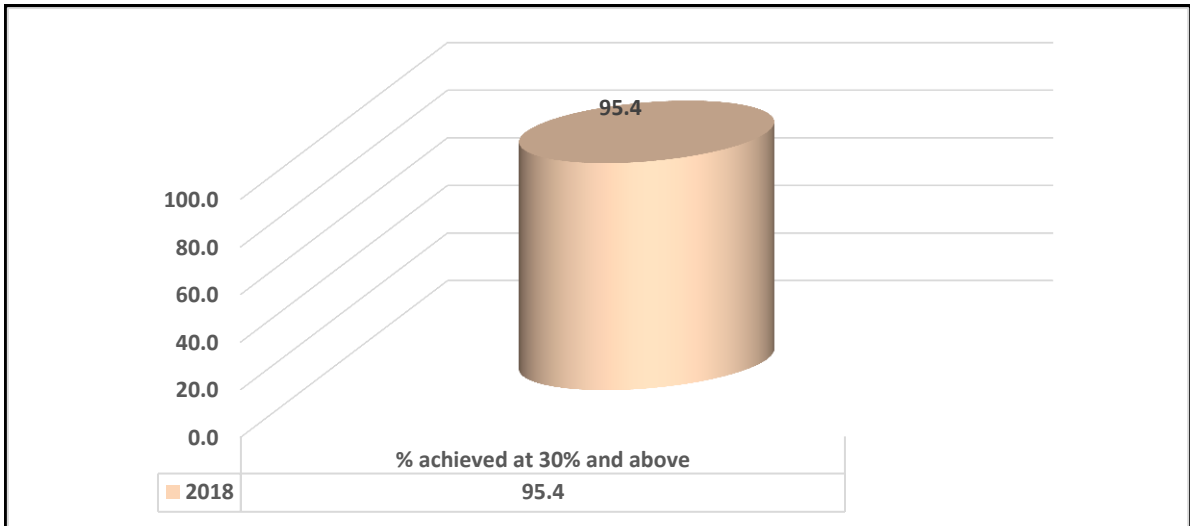
The results may improve in future, with stability in the curriculum and with teachers and learners becoming familiar with the assessment style of the subject.

**Table 5.2.1(a) Overall Achievement Rates in Fitting and Machining**

Year	No Wrote	No. achieved at 30% and above	% achieved at 30% and above
2018	2 088	1 992	95,4

There is still room for improvement in the performance of the learners if the challenges surrounding problem-solving skills, mathematical skills, conceptual understanding and integration of topics are addressed. In this regard, integrated problem solving must become an integral part of teaching and learning.

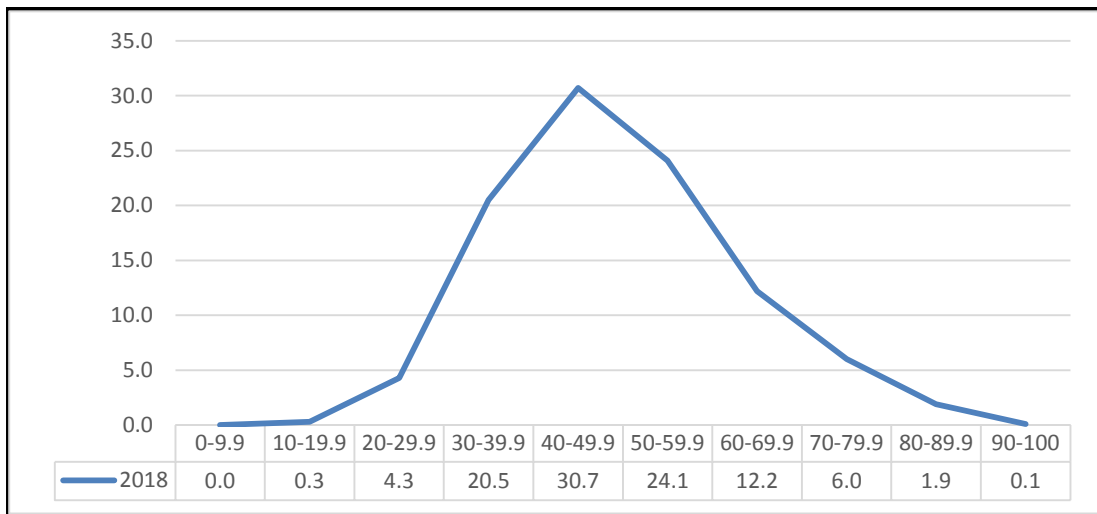
**Graph 5.2.1(b) Overall Achievement Rates in Fitting and Machining (Percentage)**



**Table 5.2.1(c) Performance Distribution in Fitting and Machining (Percentage)**

Year	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
2018	0,0	0,3	4,3	20,5	30,7	24,1	12,2	6,0	1,9	0,1

**Graph 5.2.1(d) Performance Distribution Curves in Fitting and Machining (Percentage)**



Graph 5.3.2 indicates the following performance distribution:

- 4,6% of candidates did not meet the pass requirement of 30%
- 95,4% of candidates met the pass requirement over 30%
- 8,0% of candidates achieved over 70%
- 2,0% of candidates achieved at the highest performance level over 80%.

**OVERVIEW OF LEARNER PERFORMANCE IN FITTING AND MACHINING**

## General Comments

- (a) Questions pertaining to pure recall of content were very poorly answered. Teachers are advised to use short informal assessment tasks to reinforce basic concepts and principles. This can be used to good effect in content relating to definitions, functions, labelling and operations listed in the *CAPS* and the examination guidelines.
- (b) Some candidates cannot apply formulae correctly. Teachers should emphasise the use of the relevant formula provided on the formula sheet, correct substitution and providing the answer with the correct unit and direction in terms of requirements of questions.
- (c) The application of mathematical principles is a challenge for many candidates. Learners should be given a variety of problem-solving activities that involve mathematical knowledge pertaining to the manipulation of formulae and the application of trigonometry in classwork, homework, tests and examinations.
- (d) Candidates' handwriting should not be too small and calculations should not be cramped onto one section of the page.
- (e) Learners need to be taught language skills in order to distinguish between terms such as 'before', 'during', 'while' and 'after'.
- (f) Candidates do not appear to read questions carefully and consequently do not answer certain subquestions.
- (g) Candidates revealed a lack of knowledge or exposure to the use of various tools and equipment.
- (h) Teachers seem to focus more on calculations than on theoretical concepts.
- (i) Teachers should use previous papers as support material and as exercises in the classroom especially when training learners to answer multiple-choice questions.
- (j) Worksheets and regular informal assessment, e.g. class tests, will benefit learners.
- (k) Teachers are advised to use resources, such as video clips, charts, PowerPoint presentations and additional textbooks, to illustrate the relationship between content and real-life situations.
- (l) Theory and practical tasks should be integrated in teaching and learning.
- (m) Integration of content from other subjects, such as Mathematics, Technical Mathematics, Physical Sciences, Technical Sciences and Engineering Graphics and Design will benefit learners.

- (n) Teachers and subject advisors should develop an item bank of questions and answers for the subject including factual content, calculations and drawings.
- (o) Moderation by SMTs and/or PEDs will serve to ensure that the curriculum is covered on time.
- (p) Teacher training needs to focus on setting of papers according to cognitive levels (tests and examination). Sufficient resources are available for this purpose.
- (q) Teacher training should focus on content knowledge in addition to practical training.
- (r) Schools need to adhere to the notional time when setting timetables. Double periods should be allocated for practical task.
- (s) Schools and the PED need to support teachers with resources. It became clear in the responses from the learners that they have no idea of what some of the tools and equipment look like because they are not available in the workshops at school.

### **5.2.3 ANALYSIS OF LEARNER PERFORMANCE IN EACH QUESTION IN FITTING AND MACHINING**

#### **SECTION A (GENERIC)**

#### **QUESTION 1: MULTIPLE-CHOICE QUESTIONS**

##### **Common Errors and Misconceptions**

- (a) In Q1.4 candidates could not identify the correct properties of materials.
- (b) In Q1.5 candidates could not identify the outcome of a sound.

##### **Suggestions for Improvement**

- (a) Teachers must provide worksheets to identify the different properties of materials as well as to illustrate practical demonstration in the workshop.
- (b) Learners should be exposed to informal assessment to master the content.
- (c) Teachers should conduct practical demonstration of a sound test and explain the outcome to the learners.

#### **QUESTION 2: SAFETY (GENERIC)**

##### **Common Errors and Misconceptions**

- (a) In Q2.1 candidates confused the safety measures of the angle grinder and bench grinder, revealing a lack of content knowledge on this topic.
- (b) In Q2.2 candidates could not state the correct reasons relating to welding goggles during the oxyacetylene welding process.
- (c) In Q2.5 candidates could not state responsibility of the employer when applying first aid in the workplace; instead they provided first-aid items.

### **Suggestions for Improvement**

- (a) Teachers must conduct practical demonstrations on the two-angle grinder and bench grinder to illustrate in-depth and different safety measures for each tool.
- (b) Teachers must conduct practical demonstration for the use of different safety equipment when using oxyacetylene and arc welding apparatus.
- (c) Teachers are advised to provide worksheets indicating the difference between applying and providing first aid in the workplace.

### **QUESTION 3: MATERIALS (GENERIC)**

#### **Common Errors and Misconceptions**

In Q3.4 candidates did not provide factors of heat treatment; they explained the hardening process instead.

#### **Suggestions for Improvement**

Teachers should provide worksheets to differentiate between the factors required for heat treatment and the hardening process. Theory and practice should be integrated to enhance content knowledge.



#### **5.2.4 ANALYSIS OF LEARNER PERFORMANCE IN EACH QUESTION IN FITTING AND MACHINING (SPECIFIC)**

##### **QUESTION 4: MULTIPLE CHOICE (SPECIFIC)**

###### **Common Errors and Misconceptions**

- (a) In Q4.3 candidates could not identify the advantages of gear drive system when compared to belt drive system.
- (b) In Q4.14 candidates could not identify the correct symbol for a hydraulic system.

###### **Suggestions for Improvement**

- (a) Teachers are advised to provide learners with a worksheet in tabulated form to indicate the advantages and disadvantages of belt and gear drive systems.
- (b) Teachers should expose learners to the exemplar paper and examination guidelines and provide them with worksheets and posters showing different hydraulic systems.

##### **QUESTION 5: TERMINOLOGY – LATHE AND MILLING MACHINE**

###### **Common Errors and Misconceptions**

- (a) In Q5.2 candidates used incorrect trigonometric ratios to calculate compound slide set-over.
- (b) In Q5.3 candidates demonstrated a lack of content knowledge of the centre gauge.
- (c) In Q5.7 candidates could not state the methods of centering the milling cutter.

###### **Suggestions for Improvement**

- (a) Learners should practise trigonometric ratios with similar examples using previous and exemplar papers in addition to additional examples provided by the teacher.

- (b) Teachers should revise the centre gauge section thoroughly with a variety of exercises. Worksheets and regular informal assessment (e.g. class tests) will benefit the learners.
- (c) Teachers should incorporate more practical demonstrations on how to centre the milling cutter in enhancing the teaching of this topic.

## **QUESTION 6: TERMINOLOGY- INDEXING AND DOVE TAILS**

### **Common Errors and Misconceptions**

- (a) In Q6.1, Q6.2, Q6.3 and Q6.4 candidates experienced difficulty to manipulate the formulae.
- (b) In Q6.5 candidates could not provide valid reasons why balancing work on a centre lathe is so important.

### **Suggestions for Improvement**

- (a) Teachers should practise calculations more regularly through informal assessment. Manipulation of formulae by learners could be improved by means of class work and worksheets.
- (b) Teachers must reinforce the content on the centre lathe and stress the importance of centring the work piece while working on the lathe machine.

## **QUESTION 7: TOOLS AND EQUIPMENT**

### **Common Errors and Misconceptions**

In Q 7.4 candidates did not know how to read the depth micro meter.

### **Suggestions for Improvement**

With regard to the reading of depth micro meters, teachers should use the electronic media such as YouTube, videos and presentations to supplement practical exercises in class and in the workshop.

## **QUESTION 8: FORCES**

### **Common Errors and Misconceptions**

Candidates lacked mathematical skills in substitutions and manipulation of formulae in Q8.1 on forces, Q 8.2 on moments and Q8.3 on stress and strain.

### **Suggestions for Improvement**

- (a) More exercises should be done with the learners. Worksheets on this type of calculation and the manipulation of formulae should be practised regularly. Learners should be able to explain the meaning of every entity in a formula.
- (b) The content needs to be integrated with other subjects, i.e. Mathematics, Technical Mathematics, Physical Sciences, Technical Sciences and Engineering Graphics and Design.

## **QUESTION 9: MAINTENANCE**

### **Common Errors and Misconceptions**

- (a) In Q9.4 candidates could not provide the procedure to replace the belt on the belt drive system in a correct sequence.
- (b) In Q9.6 candidates could not state the difference between thermoplastic and thermo hardened plastic.

### **Suggestions for Improvement**

- (a) Integration of theory topics and practical activity in the workshop is imperative.
- (b) As informal assessment teachers are advised to provide learners with worksheets to complete procedures in point form and to identify correct sequences during practical work.
- (c) Teachers should develop a specialised worksheet tabulated to differentiate between thermoplastic and thermo hardened plastics.

## **QUESTION 10: JOINING METHODS**

### **Common Errors and Misconceptions**

- (a) Candidates did not reflect good understanding of the terms and formulae in this section, particularly in Q10.1.2 on helix angle of the thread, Q10.1.3 on leading tool angle and in Q10.1.4 on following tool angles.
- (b) Some candidates just left blank spaces and did not attempt to answer this section.

### **Suggestions for Improvement**

Teachers must ensure that learners practise calculations more regularly to gain the confidence to do them. Additional exercises in the form of informal class activities and home activities are advised before exposing learners to a formal assessment.

## **QUESTION 11: SYSTEMS AND CONTROL**

### **Common errors and misconceptions**

Candidates did not reflect good understanding of the terms and formulae in this section, particularly in Q11.2 on hydraulic system, Q11.4 on belt drives and in Q11.5 on gear drives.

### **Suggestions for Improvement**

Teachers must ensure that learners practise calculations more regularly to gain the confidence to do them. Additional exercises in the form of informal class activities and home activities are advised before exposing learners to a formal assessment.

### 5.3 WELDING AND METALWORK

The following report should be read in conjunction with the Welding and Metalwork question paper of the November 2018 examinations.

#### 5.3.1 PERFORMANCE TRENDS (2018)

In 2018, 1 934 candidates sat for the Welding and Metalwork examination. This was the first examination of the specialisation subjects. The performance of the candidates in 2018 reflects a good achievement with 1 835 candidates, i.e. 94,9% of the cohort, passing at the 30% level and above.

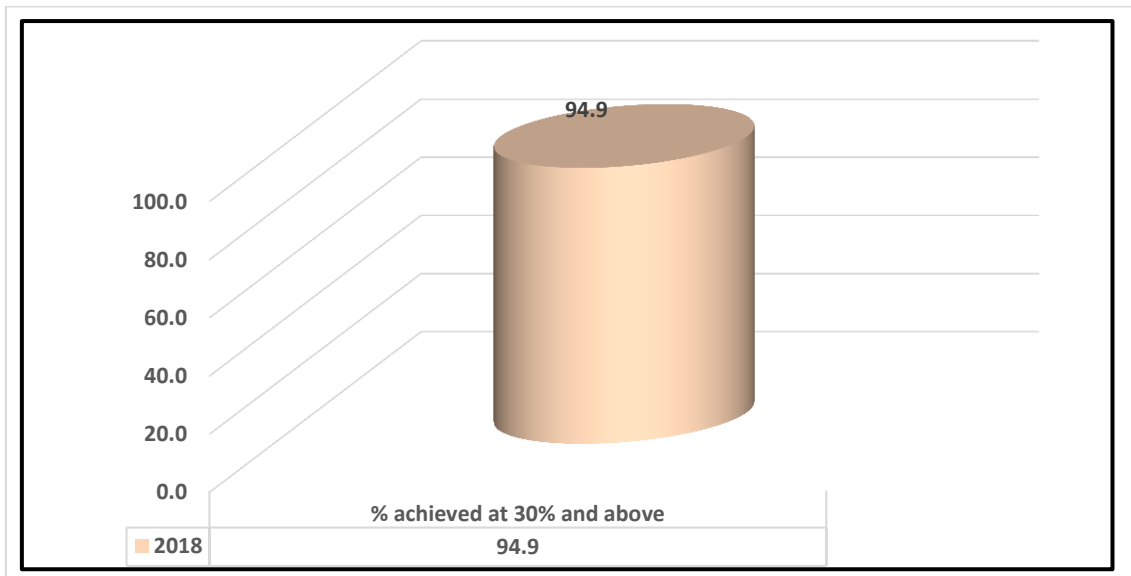
The results may improve in future, with stability in the curriculum and with teachers and learners becoming familiar with the assessment style of the subject.

**Table 5.3.1(a) Overall Achievement Rates in Welding and Metalwork**

Year	No. Wrote	No. achieved at 30% and above	% achieved at 30% and above
2018	1 934	1 835	94,9

There is still room for improvement in the performance of the learners if the challenges surrounding problem-solving skills, mathematical skills, conceptual understanding and integration of topics are addressed. In this regard, integrated problem solving must become an integral part of teaching and learning.

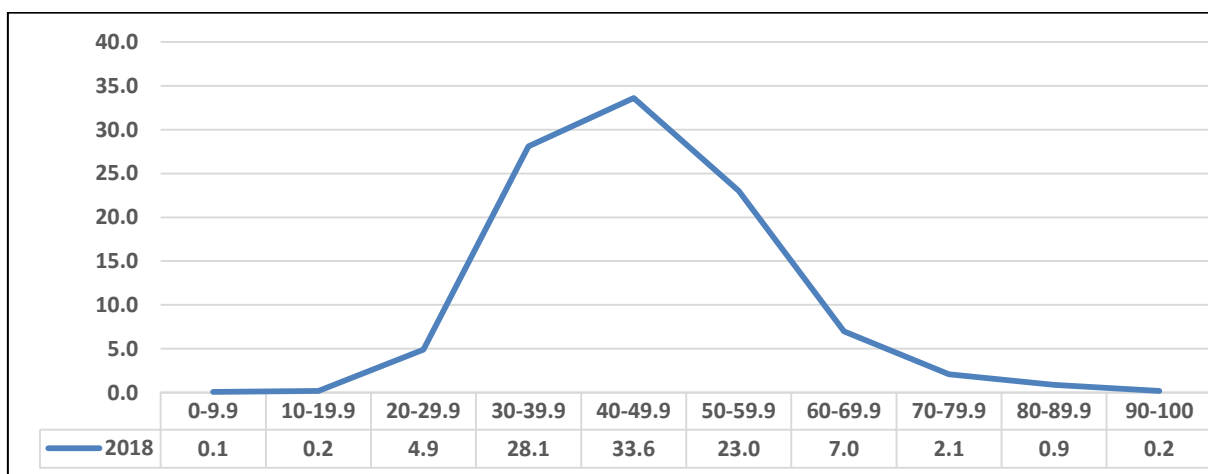
**Graph 5.3.1(b) Overall Achievement Rates in Welding and Metalwork (Percentage)**



**Table 5.3.1(c) Performance Distribution Percentage**

Year	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
2018	0,1	0,2	4,9	28,1	33,6	23,0	7,0	2,1	0,9	0,2

**Graph 5.3.1(d) Performance Distribution Curves in Welding and Metalwork (Percentage)**



Graph 5.3.2 indicates the following performance distribution:

- 5,2% of candidates did not meet the pass requirement of 30%
- 94,8% of candidates met the pass requirement over 30%
- 3,2% of candidates achieved over 70%
- 1,1% of candidates achieved at the highest performance level over 80%.

### 5.3.2 OVERVIEW OF LEARNER PERFORMANCE IN PAPER

#### General Comments

- Questions pertaining to pure recall of content were very poorly answered. Teachers are advised to use short informal assessment tasks to reinforce basic concepts and principles. This can be used to good effect in content relating to definitions, functions, labelling and operations listed in the *CAPS* and the examination guidelines.
- Some candidates cannot apply formulae correctly. Teachers should emphasise the use of the relevant formula provided on the formula sheet, correct substitution and providing the answer with the correct unit and direction in terms of requirements of questions.
- The application of mathematical principles is a challenge for many candidates. Learners should be given a variety of problem-solving activities that involve mathematical knowledge pertaining to the manipulation of formulae and the application of trigonometry in classwork, homework, tests and examinations.
- Candidates' handwriting should not be too small and calculations should not be cramped onto one section of the page.
- Learners need to be taught language skills in order to distinguish between terms such as 'before', 'during', 'while' and 'after'.
- Candidates do not appear to read questions carefully and consequently do not answer certain subquestions.
- Candidates revealed a lack of knowledge or exposure to the use of various tools and equipment.
- Teachers seem to focus more on calculations than on theoretical concepts.
- Teachers should use previous papers as support material and as exercises in the classroom especially when training learners to answer multiple-choice questions.
- Worksheets and regular informal assessment, e.g. class tests, will benefit learners.

- (k) Teachers are advised to use resources, such as video clips, charts, PowerPoint presentations and additional textbooks, to illustrate the relationship between content and real-life situations.
- (l) Theory and practical tasks should be integrated in teaching and learning.
- (m) Integration of content from other subjects, such as Mathematics, Technical Mathematics, Physical Sciences, Technical Sciences and Engineering Graphics and Design will benefit learners.
- (n) Teachers and subject advisors should develop an item bank of questions and answers for the subject including factual content, calculations and drawings.
- (o) Moderation by SMTs and/or PEDs will serve to ensure that the curriculum is covered on time.
- (p) Teacher training needs to focus on setting of papers according to cognitive levels (tests and examination). Sufficient resources are available for this purpose.
- (q) Teacher training should focus on content knowledge in addition to practical training.
- (r) Schools need to adhere to the notional time when setting timetables. Double periods should be allocated for practical task.
- (s) Schools and the PED need to support teachers with resources. It became clear in the responses from the learners that they have no idea of what some of the tools and equipment look like because they are not available in the workshops at school.

### **5.3.3 ANALYSIS OF LEARNER PERFORMANCE IN EACH QUESTION IN WELDING AND METALWORK (GENERIC)**

#### **SECTION A (GENERIC)**

#### **QUESTION 1: MULTIPLE-CHOICE QUESTIONS**

##### **Common Errors and Misconceptions**

- (a) In Q1.4 candidates could not identify the correct properties of materials.
- (b) In Q1.5 candidates could not identify the outcome of a sound.

##### **Suggestions for Improvement**

- (a) Teachers must provide worksheets to identify the different properties of materials as well as to illustrate practical demonstration in the workshop.
- (b) Learners should be exposed to informal assessment to master the content.



- (c) Teachers should conduct practical demonstration of a sound test and explain the outcome to the learners.

## **QUESTION 2: SAFETY (GENERIC)**

### **Common Errors and Misconceptions**

- (a) In Q2.1 candidates confused the safety measures of the angle grinder and bench grinder, revealing a lack of content knowledge on this topic.
- (b) In Q2.2 candidates could not give correct reasons relating to welding goggles during the oxy-acetylene welding process.
- (c) In Q2.5 candidates could not state the responsibility of the employer when applying first aid in the workplace; instead they provided first-aid items.

### **Suggestions for Improvement**

- (a) Teachers must conduct practical demonstrations on the two-angle grinder and bench grinder to illustrate in-depth and different safety measures for each tool.
- (b) Teachers must conduct practical demonstrations of the use of different types of safety equipment when using oxyacetylene and arc welding apparatus.
- (c) Teachers are advised to provide worksheets indicating the difference between applying and providing first-aid in the workplace.

## **QUESTION 3: MATERIALS (GENERIC)**

### **Common Errors and Misconceptions**

In Q3.4 candidates did not provide factors of heat treatment; they explained the hardening process instead.

### **Suggestions for Improvement**

Teachers should provide worksheets to differentiate between the factors required for heat treatment and the hardening process. Theory and practice should be integrated to enhance content knowledge.

#### **5.3.4 ANALYSIS OF LEARNER PERFORMANCE IN EACH QUESTION IN WELDING AND METAL WORK (SPECIFIC)**

##### **QUESTION 4: MULTIPLE CHOICE (SPECIFIC)**

###### **Common Errors and Misconceptions**

- (a) In Q4.6 most candidates could not calculate the value of force X on a moment.
- (b) In Q4.7 most candidates could not identify the type of force shown in Figure 4.7.

###### **Suggestions for Improvement**

- (a) Teachers must thoroughly revise Grade 10 work on moments.
- (b) Teachers should use previous papers as support material and as tasks in the class room in order to train learners in answering multiple choice questions.

##### **QUESTION 5: TERMINOLOGY (TEMPLATE)**

###### **Common Errors and Misconceptions**

- (a) Q5.2 required the purpose of purlins as used on roof trusses; however, most candidates described the purpose of a roof truss.
- (b) In Q5.3 most candidates could not calculate the dimensions required to fabricate the steel ring.
- (c) In Q5.4 most candidates could not identify the various weld symbols.

###### **Suggestions for Improvement**

- (a) Learners should be trained to read and interpret questions carefully to ensure that they respond appropriately to the requirements of the questions.
- (b) Teachers are advised to provide more examples to enable learners to master the calculation skills and to identify the weld symbols. Theory and practice should be integrated in the teaching and learning process.

- (c) Practical demonstrations will assist learners in mastering calculations and applications for fabricating the shapes required. Teachers are advised to make use of charts to illustrate the various weld symbols.

## **QUESTION 6: TOOLS AND EQUIPMENT**

### **Common Errors and Misconceptions**

- (a) Q6.1 required the working principle of the guillotine and bending rolls; however, most candidates answered on the uses of these machines.
- (b) Q6.2 required the primary function of a regulator on gas cylinders; however, many candidates answered on the functions of the dial gauge fitted onto the regulator. Candidates tend to regard the regulator and the gauges as a unit.

### **Suggestions for Improvement**

- (a) Learners should practise explanations on how specific machines function in detail and should work on the machines to experience the work practically. Videos and charts can be used to enhance the teaching and learning process in the workshops. Integration of theory topics and practical activities in the workshop is imperative.
- (b) Learners should be offered more opportunities to work on oxyacetylene equipment and assemble different components.

## **QUESTION 7: FORCES**

### **Common Errors and Misconceptions**

- (a) In Q7.1 most candidates displayed a lack of drawing skills relating to diagrams for space, bending moment and shear force.
- (b) In Q7.2 candidates calculated the right reactions and left reactions incorrectly by

switching left with right.

### **Suggestions for Improvement**

- (a) Teachers should use previous papers as support material to facilitate drawing exercises in the classroom. Each step in the calculation should be discussed using Bow's rotation for framework. Teachers should aim to integrate concepts and applications from the subject of Engineering Graphics and Design regarding drawings to enhance answering of the question.
- (b) Teachers are advised to cover the content thoroughly by emphasising the turning point. Technical Mathematics and Technical Sciences curricula should adequately support the specialisation as they have similar content on this topic. Teachers should start with simple calculations regarding reactions and bending moments in progressing to the bending moment's diagram. Learners must be guided on how to use the formulae and apply them step by step to calculate stress and strain.

## **QUESTION 8: JOINING METHODS – WELD INSPECTION**

### **Common Errors and Misconceptions**

- (a) Q8.1 required the factors to be observed during oxyacetylene welding; however, candidates answered on arc welding.
- (b) Q8.3 required causes of weld defects; however, many candidates explained what the weld defects are.
- (c) Q8.5 required the difference between destructive and non-destructive tests; however, many candidates named examples of the tests without emphasising the differences.

### **Suggestions for Improvement**

- (a) Teachers should use previous papers as support material and tasks in the class room. The methodology of teaching should cover comparisons between arc and gas welding.
- (b) Videos and charts should be used in teaching the weld defects. Integration of theory topics and practical activity in the workshop is imperative.
- (c) Teachers should use video clips, charts, PowerPoint presentations and additional text books to illustrate the relationship between theoretical content and real-life situations.

## **QUESTION 9: JOINING METHODS-STRESSES AND DISTORTION**

### **Common Errors and Misconceptions**

- (a) Q9.5 required factors on distortion and residual stress; however, many candidates answered on how distortion and residual stress takes place and not on the factors.
- (b) Q9.6 required an explanation of the internal and external effect on metal when it is cooled rapidly; however, many candidates answered on how case hardening is done when the metal is cooled rapidly.

### **Suggestions for Improvement**

- (a) Learners need to be taught language skills to distinguish between factors and principles of operation.
- (b) Learners also need to be taught language skills to distinguish between effects and description of processes.

## **QUESTION 10: MAINTENANCE**

Learners performed well in this question. This section covered maintenance which had general answers as most machines have common procedures for servicing and maintenance.

## **QUESTION 11: DEVELOPMENT BY CALCULATIONS**

### **Common Errors and Misconceptions**

- (a) Q11.1 required a description of the function of transformers used in ventilation of ducts; however, most candidates answered on electrical transformers or ducting in general.
- (b) Candidates struggled with Q11.3 because of the mathematical knowledge required.

### **Suggestions for Improvement**

- (a) Learners need to be taught to use models when developing explanations for what transformers are. Simulations and videos should be used by educators to support teaching and learning. Integration of theory topics and practical activity in the workshop is imperative.
- (b) The mathematical literacy of learners should be enhanced to enable them to deal with trigonometry and geometry problems more effectively. Additional worksheets on calculations are advised.