Province of the
EASTERN CAPE
EDUCATION

EXAMINATIONS AND ASSESSMENT CHIEF DIRECTORATE
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2023 NSC CHIEF MARKER'S REPORT

SUBJECT	**TECHNICAL MATHEMATICS**		
QUESTION PAPER	1	2	3
DURATION OF QUESTION PAPER	**3 HRS**		
PROVINCE	**EASTERN CAPE**		
DATES OF MARKING	**05 – 18 DECEMBER 2023**		

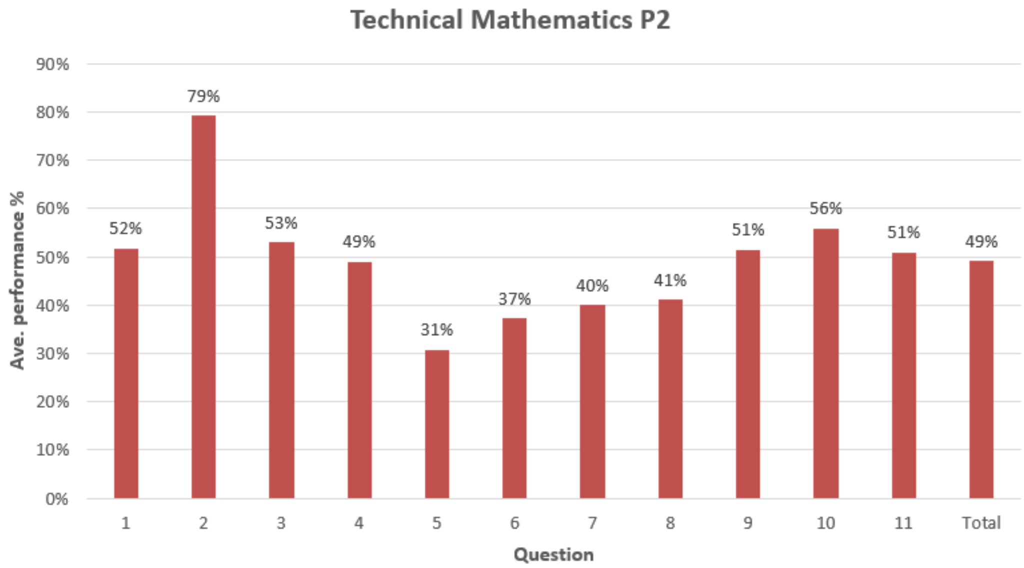
SECTION 1: (General overview of Learner Performance in the question paper as a whole)

The number of Eastern Cape NSC candidates that wrote the 2023 final NSC Technical Mathematics paper 2 was 2728. Highest mark recorded as 144 and another two candidates recorded marks of 135.

The number of level five to seven candidates shows an increase in comparison with 2022, further number of level seven candidates have increased over 100%.

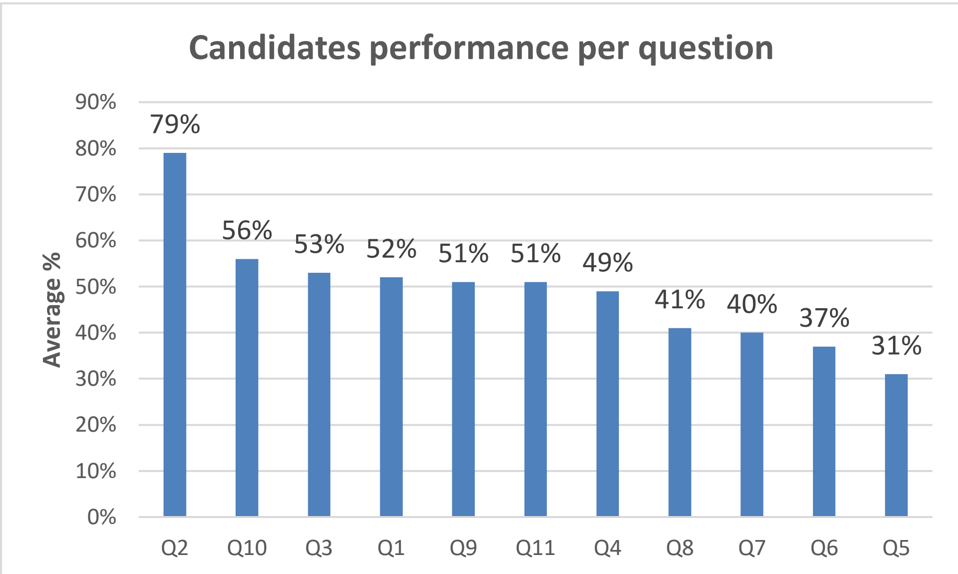
The number of level ones decreased as well, and this shows that the system is starting to improve. Teachers and learners are getting used to the curriculum. Yes, there are still many challenges because the bulk of the learners is still performing at level one. Disappointing is the fact that there are still learners scoring no marks for this paper and marking batches of which none of the candidates were passing.

A sample of 100 scripts was collected during the marking process. The sample space comprised off 30% levels one and two: 43% levels three and four and 27% levels five to seven.



Q1	Analytical Geometry: lines
Q2	Analytical Geometry: circle & ellipse
Q3	Trigonometry: definitions, diagrams & equations
Q4	Trigonometry: identities & reductions
Q5	Trigonometry: graphs
Q6	Trigonometry: 2D
Q7	Euclidean Geometry: circle
Q8	Euclidean Geometry: circle
Q9	Euclidean Geometry: proportion
Q10	Angles, and angular movement; height of segment
Q11	Mensuration

The questions as ordered from high to low by the performance of the sampled data are indicated in the diagram below:



- The average performance in sampled candidates stands at 49%. This higher than previous years.
- Question two was the best performing question with question five the worst performing question.

- The expectation is that the performance of the 2023 candidates will be better than 2022.

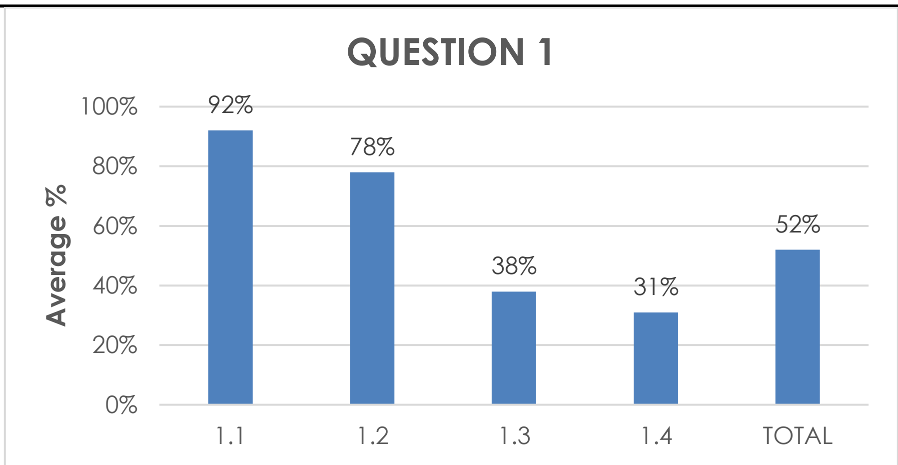
Reality of the matter is that most of the learners are failing the examination and the graph would be skewed to the right or clustered to the left, to the level ones. However, the number of level ones have drastically reduced.

SECTION 2: Comment on candidates' performance in individual questions

The report will attempt to address the following questions:	
(a)	General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
(b)	Why the question was poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
(a)	Provide suggestions for improvement in relation to Teaching and Learning
(b)	Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

QUESTION 1 [Total marks 14]

- The fifth best question answered at 52% average.



- Q1.1: only 4% could not score any marks whilst 8% scored one mark, either the substitution mark or the simplification mark. Disappointingly 1.1 did not perform at 100%, since it required learners to calculate the gradient (a grade10 concept)
- Q1.2: only 5% could not score any mark; 5% score one mark; 41% scored 2 marks and 49% scored full marks
- Q1.3: only 13% scored full marks; 36% scored no marks
- Q1.4: only 22% scored full marks; 62% scored no marks

Common errors and misconceptions

- Q1.1 – learners switching the numerator and denominator – a very sloppy mistake
- Q1.2 – Most learners still do not realise the reference angle is a positive acute angle and hence a negative gradient resulting in a obtuse angle.
- Q1.3 – many learners did not know how to prove that a point lies or does not lie on a line. 27% of candidates stopped by calculating the equation only.
- Q1.4 – most learners did not realise that they are working with a right-angled triangle and thus could have used the basic formula $\frac{1}{2} base \times \perp\ height$

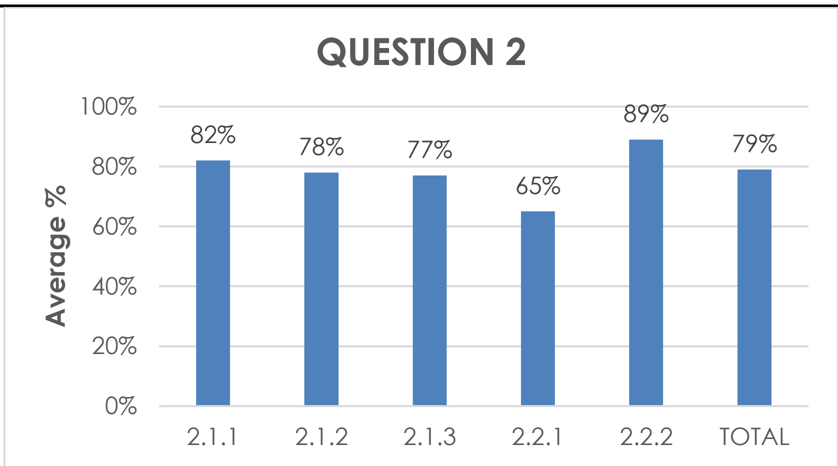
Suggestions for improvement

i.) Teachers need to create opportunities where learners can practise to show how to prove that a point lies on a figure or not.

ii.) Learners should recognise to calculate the area of a triangle, there are only two options: right-angled triangle we use $\frac{1}{2} base \times \perp\ height$ and a non-right-angled triangle we use the area rule. Learners should have recognised the given right-angle as a give away

QUESTION 2 [Total marks 10]

- The best answered question at 79% average.



- Q2.2.1 was the only sub-question that candidates struggled with, writing the ellipse in standard form

Common errors and misconceptions

- Q2.1.1: Not writing the equation in standard form: $x^2 + y^2 = 225$
- Q2.1.3: many could not calculate the reciprocal gradient and other committed simplification mistakes
- Q2.2.1 Candidates were required to write the elliptical equation into standard form, and many did not know what to do with 11, not realising that $11 = \left(\sqrt{11}\right)^2$

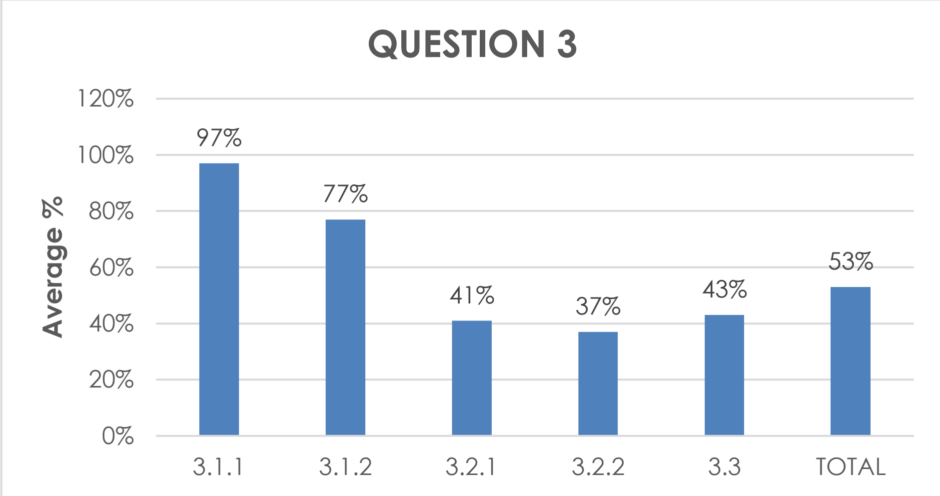
Suggestions for improvement

i.) Teachers to expose learners into different writing of the ellipse in standard form

ii.) A simpler method to calculate the equation of a tangent to a circle with less mistakes is to use the formula $xx_1 + yy_1 = r^2$

QUESTION 3 [Total marks 14]

- This was the second best answered question, drop off more than 26% in comparison with question 2.



- Almost 60% of the candidates could not get the correct answer
- Q3.3 was surprisingly poorly answered.

Common errors and misconceptions

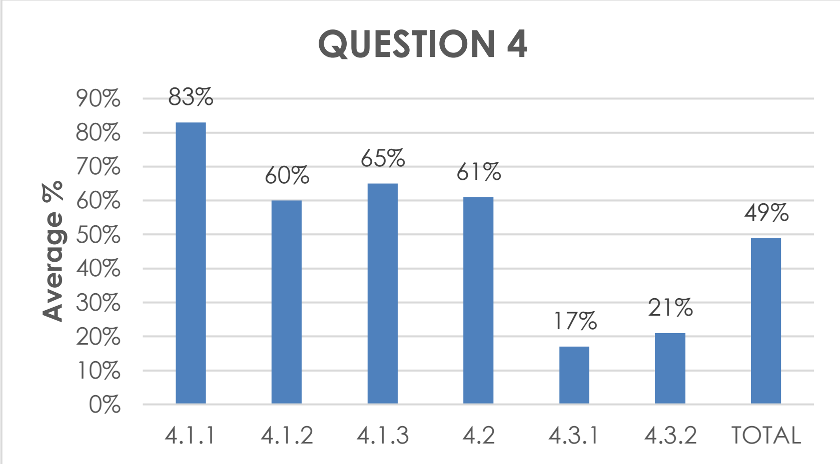
- Q3.1.2: many candidates confused the reciprocal identity of secant
- Q3.2:
  - many candidates could not identify the correct quadrant of the angle and therefore the diagram, thus they did not realise that $x = -3$
  - Surprisingly, many learners struggle applying Pythagoras theorem correctly even substituting the radius as -5.
  - Many do not understand that the hypotenuse is the longest side of a right-angle triangle
  - Many candidates do not understand their definitions of the ratios as they could not correctly identify the values of $x, y\ OR\ r$. With the results many ended up with one of the sides longer than the hypotenuse.
  - Q3.2.1:
    - Still too many candidates wrote incorrectly $cosec\left(-\frac{5}{4}\right)$, although not penalised this time around, in the future learners will be penalised.
    - Many could not read off the cosecant definition directly from the given sine ratio
    - Many candidates ignored the negative sign
  - Q3.2.2
    - A few learners calculated the value of β, whilst the question clearly stipulated without a calculator: these learners scored no marks for Q3.2.2.
    - Not showing all work, especially if a mistake was made, no CA marks could be awarded.

- Q3.3: many candidates only calculated up to the reference angle whilst others only calculate the obtuse angle and totalling ignoring the other angle. Further, many candidates wrote reference angle with an obtuse answer.

Suggestions for improvement

i.) Learners must be able to correctly distinguish between the ratio and its angle.
ii.) The use of reciprocal ratios and the calculator must be practice more often
iii.) $trig\ ratio\ (angle) = value$ vs the incorrect statement $trig\ ratio\ (value)$
iv.) Learners must practice determining the correct quadrant of angles and diagrams in different scenarios
v.) Further, the hypotenuse is the longest side of a right-angled triangle
vi.) Learners must make sure the calculators as set in degrees mode
vii.) Learners must be more exposed to equations where their values are negative
viii.) The word reference angle is reserved for a positive acute angle

QUESTION 4 [Total marks 15]
• Question performed at 49%, the seventh position in performance



- Q4.3.1: 86% of candidates could not factorise the question
- Q4.3.2: even the top learners struggled to simplify this question

Common errors and misconceptions

- Q4.2: $sin^2(360° - A)$ was simplified to $-sin^2 A$. Further, many candidates changed the addition operator to a multiplication operator. Either one of these mistakes impacted on the last mark for this question.
- Q4.3.1: $\sec x - sec^2 x$ is incorrectly simplified to $-\sec x$
- Q4.3.2: many candidates cancelled sec x incorrectly in the following statement: $\frac{cosec\ x - cosec\ x \sec x}{\sec x - (tan^2 x + 1)}$ this resulted that they could not simplify any further
- Also, the numerator was incorrectly simplified as $cosec\ x - cosec\ x \sec x = \sec x$
- Algebraic skills are seriously lacking, and candidates complicated the problem by using reciprocal identities
- Many learners did not identify the identity $tan^2 x + 1 = sec^2 x$

Suggestions for improvement

i.) Learners use the formula sheet effectively as these identities are provided.

ii.) A deliberate session must be set aside to go through the formula sheet from grades 10 to 12

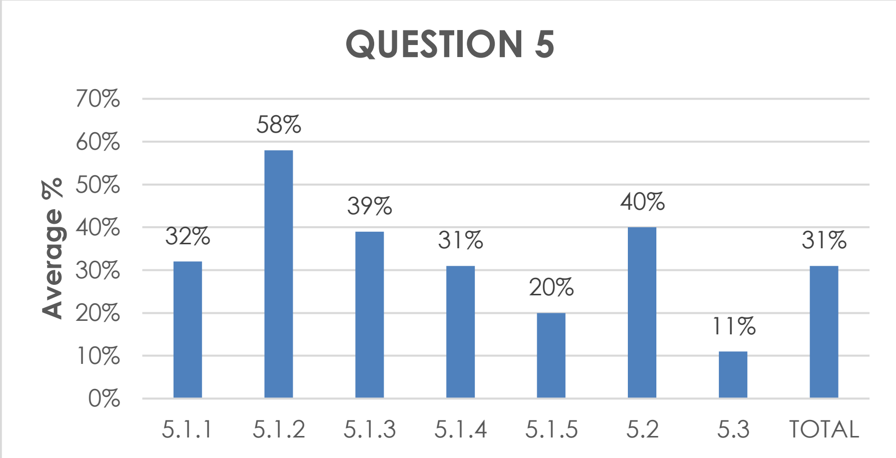
iii.) Practical examples must be done to explain that $\frac{a+b}{b+c} \neq \frac{a}{c}$.

iv.) Further, show that $\frac{a \times b}{b \times c} = \frac{a}{c}$, but not when we add or subtract.

v.) Also address the following incorrect application of BODMAS: $a - ac \neq c$ especially with trigonometric functions.

vi.) ANY identity squared or to an even power will result in a positive answer.

QUESTION 5 [Total marks 11]
• This was the worst performing question at 31% average.



- This time around the graphs were given and learners had to make deductions from the graph
- Only one sampled candidate scored full marks for this question
- Q5.1.1: only 32% of candidates could determine the value of a
- Q5.3: the question on decreasing function was the worst answered question, with only 6% scoring full marks

Common errors and misconceptions

- The teaching of the properties of the graphs seems to be seriously lacking
- Q5.1.1: Many ignored the period of the graph and assumed the value of $a = 1$ because they saw a full circle graph
- Q5.1.3: Many candidates could not transpose the given information $\tan x = 1$ which would have simplified the problem for them
- Q5.1.4: Many candidates could not identify the range of the function correctly; this was assumed as a basic concept
- Q5.3: use of square brackets instead of round brackets

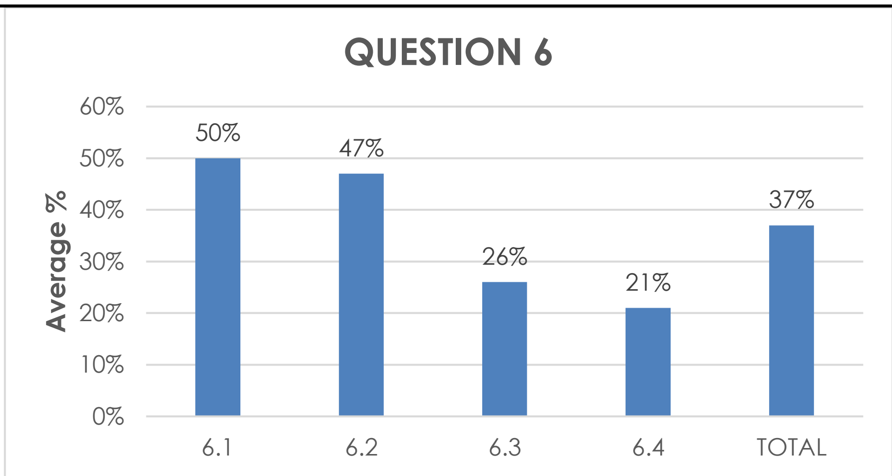
Suggestions for improvement

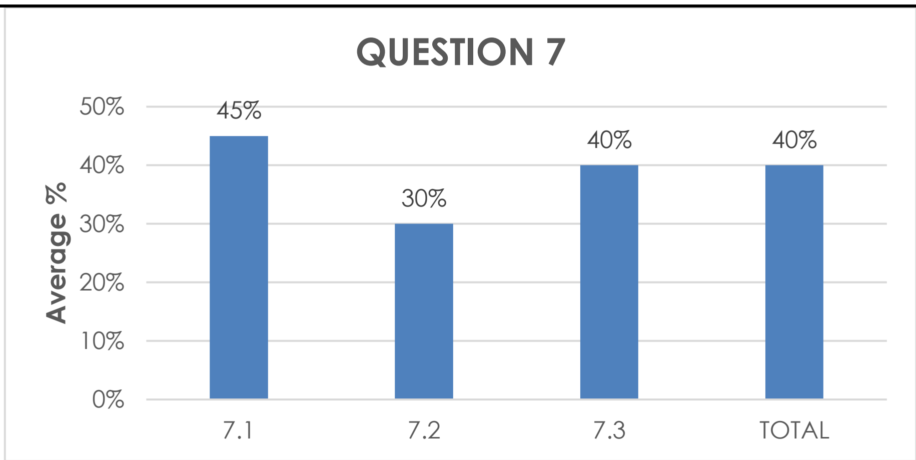
i.) Learners must be versed in the properties of the different graphs, e.g., domain, range, asymptotes, turning points

ii.) Reading off different intervals from various scenarios, e.g., positive graphs $(f(x) > 0)$, negative graphs $(f(x) < 0)$

iii.) Combinations of graphs: $f(x).g(x) \geq 0$; $x.f'(x) > 0$

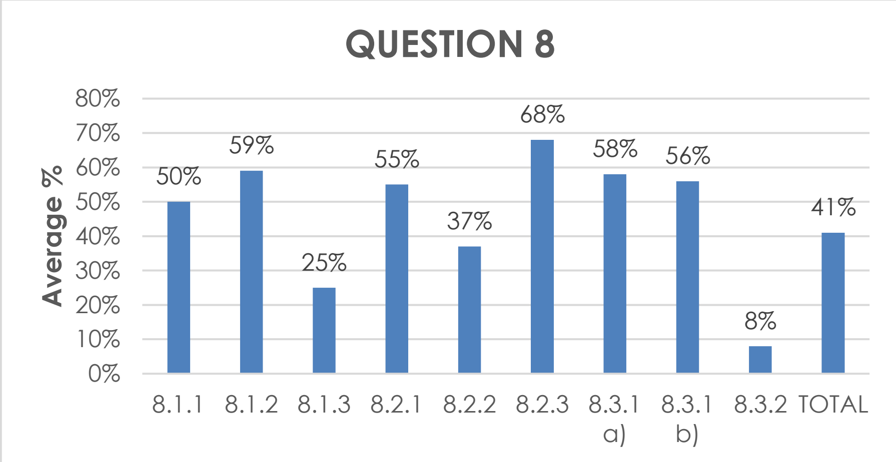
iv.) Increasing / Decreasing functions: note the turning points are not included

QUESTION 6 [Total marks 9]
• Second last worst performing question of the paper at 37% average.

• Eight percent of sampled candidates scored full marks. • Q6.3: Only 26% of candidates could the ratio correctly • Q6.4: 18% of sampled candidates scored full marks for this question
Common errors and misconceptions
• Q6.1: Many candidates did not realise that they must calculate $Q\hat{R}P$ first and then apply the sine rule to determine the length of PR • Q6.2: Many candidates just wrote down the given angle of 49° instead of the complement • Q6.3: This was a simple definition problem that learners could not answer. They might not have realised that $\hat{M} = 90°$, although it was given in the statement • Q6.4: The challenge with Q6.3 resulted that most learners could not calculate the length of MT.
Suggestions for improvement
i.) Learners must first identify the right-angled triangle and possible lengths or angles that can easily be calculated or by using the basic trigonometric definitions ii.) Secondly, in the non-right-angled triangle it is either the sine or cosine rule that must be applied iii.) The calculating the length of the common side, to the different type of triangles, is critical in solving 2D or 3D problems

QUESTION 7 [Total marks 6]
• This question was the worst of Euclidean Geometry, although not a lot of marks.

• Q7.1 – only one sampled candidate scored full marks for this question • Q7.2 – only 32% of the candidate could provide the correct reason • Q7.3 – 32% of learners scored full marks in this question
Common errors and misconceptions
• Q7.1 & Q7.2 most candidates could not give the correct statement of the theorem • A simple mark for AM = 4 was lost by many candidates, resulting that they could not calculate AO. • Q7.3 incorrect application of the Pythagoras theorem – in one instance a learner wrote $x^2 = y^2 + r^2$
Suggestions for improvement
i.) Learners need more time in understanding the wording and application of theorems ii.) Learners must know their theorems: what information is given and what is the deductions from the given information. iii.) Pythagorean theorem: Only applicable in a right-angled triangle; hypotenuse (r) is the longest side

QUESTION 8 [Total marks 26]

- This question performed at 41% average.
- Better performance in comparison with previous years



- Six percent of sampled candidates scored 20 marks or above for this question. One candidate scored full marks
- 46% of sampled candidates scored below 10 marks for this question
- Q8.1.3: 68% of sampled candidates did not score any marks in this question
- Q8.3.2: 82% of sampled candidates did not score any marks for this sub-question

Common errors and misconceptions

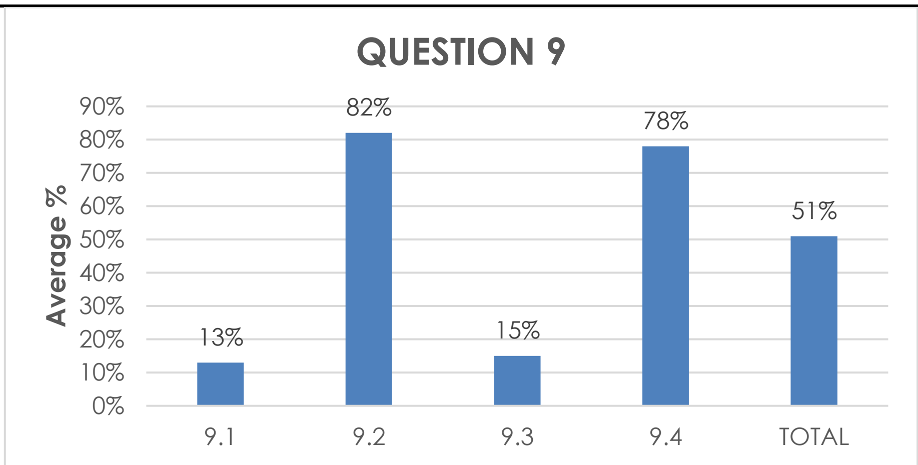
- Reasons provided are not aligning with the examination guidelines
- The use of non- CAPS terminology, like "bowtie-theorem" or "central angle theorem", isosceles triangle, radii, etc must seriously being discourage because the learners are marked incorrectly
- Incorrect statement, e.g. ∠s on the same chord instead of ∠s in the same segment
- Q8.2.2: many identified incorrectly that $\hat{E}$ is common instead of $\hat{E}_1 = \hat{E}_2(\text{vertical opp.}\angle s)$: common means the angle belongs to both triangles and it is not in this case.

Suggestions for improvement

i.) Teacher must consult the examination guidelines
ii.) The correct reasons must be practice from as early as grade 8
iii.) Enough exercises to develop learners "geometry eye"

QUESTION 9 [Total marks 7]

- Far better performance as in comparison with previous years.
- The question performed at 51% average.
- Fifth best question of the paper.
- In the past this question was reserved for proportions and similarity.
- The similarity part was asked in question 8.



- Only two learners scored full marks for this question, whilst 12% of sampled candidates scored no marks.
- Q9.1: 87% of sampled candidates did not score any marks
- Q9.2: 79% of sampled candidates scored full marks
- Q9.3: 77% of sampled candidates did not score any marks

Common errors and misconceptions

- Q9.1: many candidates left out mentioning of the parallel lines
- Q9.3: completing the statement and providing the correct reasons was again the problem
- Q9.2 & Q9.4: many candidates attempted to use Pythagoras to solve the problem.

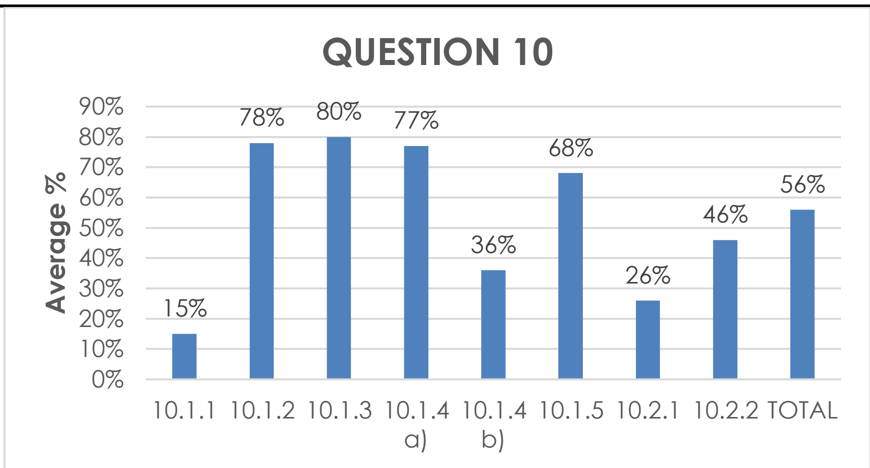
Suggestions for improvement

i.) The use of correct reasons by examination guidelines must become a norm in the classroom

ii.) The direct use of Pythagoras is only applicable in a right-angled triangle

QUESTION 10 [Total marks 20]

- This was the second best answered question in the paper at an average of 56%.



- None of the sampled candidates could score full marks, but two scored 19 out of 20.
- Only three sampled candidates scored no marks for this question.
- Q10.1.4 b): 42% of sampled candidates did not score any marks, whilst 16% scored full marks
- Q10.2.1: only 26% of the sampled candidates could calculate the correct height.

Common errors and misconceptions

- Q10.1.4 b): Most candidates did not know that they had to equate the circumferential velocity of the two pulleys to able to calculate the rotational frequency
- Q10.2.1: Many candidates just wrote 0,72 as their answer, the value with which the height is increased, instead of adding this value to the breadth of the board, this was a reading challenge.

Suggestions for improvement

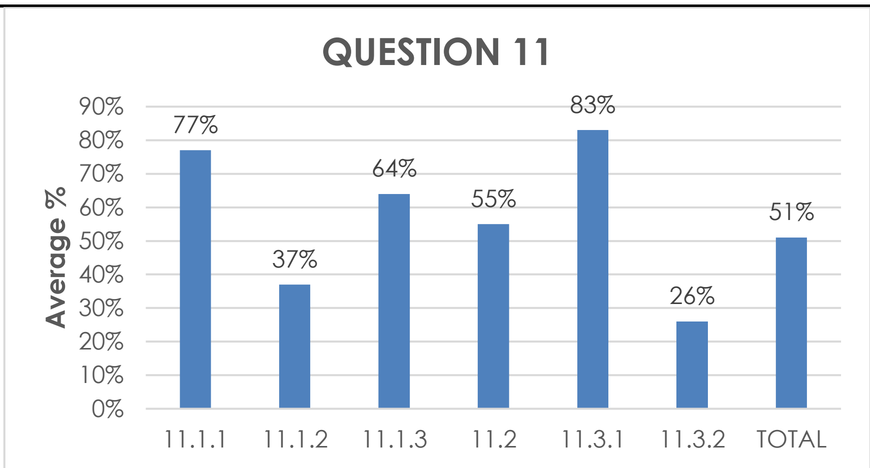
i.) Reading with or for understanding seems to be a challenge that needs a collective effort from all parties.

ii.) In this section, learners must remember that when we work with angles that $\pi = 180°$ and to convert degrees to radians we calculate it as follows: $\text{angle in degrees} \times \frac{\pi}{180°}$ and if want to convert radians to degrees as follows: $\text{angle in radians} \times \frac{180°}{\pi}$

iii.) If we work with velocity $\pi \approx 3{,}14$

QUESTION 11 [Total marks 18]

- This question performed at an average of 51%



- Only one sampled candidate scored full marks and one sampled candidate scored no marks.
- Q11.1.2: 63% of sampled candidates did not score any mark
- Q11.3.2: 39% of sampled candidates did not score any mark

Common errors and misconceptions

- Replacing π with $180°$ without converting the final answer back to radians
- Q11.1.3: copying the formula incorrectly from the formula sheet
- Q11.1.2: candidates did not know the meaning of average of the third and fifth ordinates
- Q11.3.2: candidates did not know how to increase or decrease by a certain percentage

Suggestions for improvement

i.) Emphasise with learners that the velocity formulae, $\pi \approx 3{,}14$ the value and not the angle, if they use the degrees they must convert to radians in their final answer.

ii.) Teaching for conceptual understanding should eliminate the problem.

iii.) Average:

   a. The concept of average is used in Calculus, where speak about the average gradient change between two points (functions) vs the gradient at a point.

   b. Further, average is also used to calculate the axis of symmetry of a parabola when the roots are given or known

iv.) Percentage calculations:

   a. Expose learners how to calculate a certain percentage from a value

   b. To decrease or increase a value by a certain percentage

   c. The reverse: to determine with what percentage a certain value increased or decreased