EXAMINATIONS AND ASSESSMENT CHIEF DIRECTORATE
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2024 NSC CHIEF MARKER'S REPORT

SUBJECT	**TECHNICAL MATHEMATICS**		
QUESTION PAPER	**1**	**2**	**3**
DURATION OF QUESTION PAPER	**3 HOURS**		
PROVINCE	**EASTERN CAPE**		
NAME OF THE INTERNAL MODERATOR	**L.V. CUNNINGHAM**		
NAME OF THE CHIEF MARKER	**H. ZEELIE**		
DATES OF MARKING	**29/11/2024 – 10/12/2024**		
HEAD OF EXAMINATION:	**MR E MABONA**		

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

The number of Eastern Cape NSC, SC and MEO candidates that wrote the final NSC Technical Mathematics Paper 2 for 2024 was 2881, which is a 153 more than in 2023.

A sample of 100 scripts was collected during the marking process. The selected sample comprises of scripts that were moderated by the Internal Moderator and/or Chief Marker, and/or the Senior Marker and some non-moderated scripts.

The graphical representation in the report will be based on the 100 sampled candidates' responses which were selected as depicted in the next table:

	[0; 44]	**[45; 59]**	**[60; 74]**	**[75; 89]**	**[90; 104]**	**[105; 119]**	**[120; 150]**	**TOTAL**
Required	**15**	**15**	**20**	**20**	**20**	**5**	**5**	**100**
Actual	**15**	**15**	**18**	**25**	**15**	**8**	**4**	**100**
Percentage	**15%**	**15%**	**18%**	**25%**	**15%**	**8%**	**4%**	**100%**

The 2024 cohort performed better than the cohort of 2023, when looking at the pass percentages. When looking at the 7-point scale, there is also an improvement in the level distributions from 2023 to 2024 and from previous years. There has been a 3,1% increase in the pass rate for Technical Mathematics Paper 2 from 2023 to 2024. There is a total of 37 Level 7's, which is two more than in 2023.

Technical Mathematics Paper 2 is, unfortunately, still failing in its aim as quoted in the CAPS document (*"(d) The National Curriculum Statement Grades R – 12 aims to produce candidates that are able to: • identify and solve problems and make decisions using critical and creative thinking;"*), as the bulk of the candidates still performs at level 1.

The average performance of the sampled 100 candidates of the questions, is depicted in the graph below:

KEY:

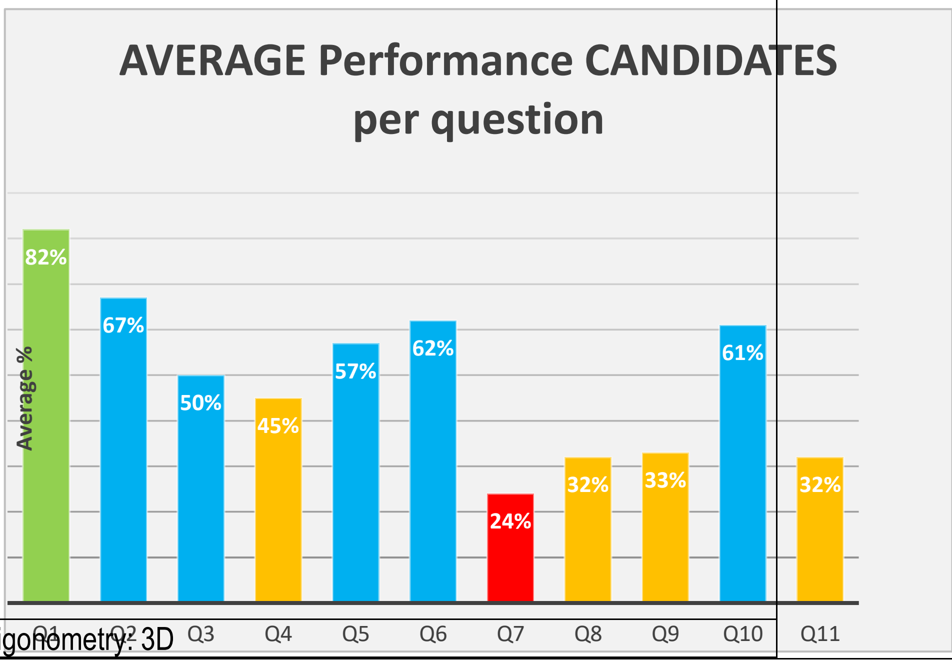
Green - > 80%

Blue – < 80%, but > 50%

Green - < 50%, but > 30%

Red - < 30%

Q1	Analytical Geometry: Lines
Q2	Analytical Geometry: Circle and Ellipse
Q3	Trigonometry: Definition; Identities and Equations
Q4	Trigonometry: Reductions
Q5	Trigonometry: Graphs
Q6	Trigonometry: 3D



Q7	Euclidean Geometry: Circle
Q8	Euclidean Geometry: Circle
Q9	Euclidean Geometry: Ratio's; Proportionality and Similarity
Q10	Circles, Angles and Angular Movement
Q11	Mensuration

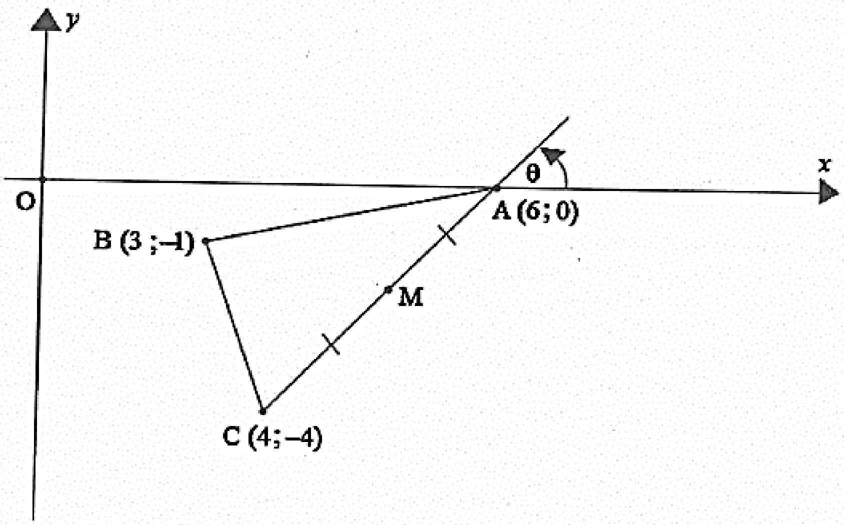
Overall the performance of the 100 sampled candidates showed some improvement throughout the paper, making them perform better than the 2023 cohort. Question 1 (Analytical Geometry) was the best performing question in 2024, with Question 7 (Analytical Geometry: Circle) performing very poorly at 24% average for the sampled candidates. Overall more questions were attempted by candidates and there were few papers were questions were left completely blank. Euclidean Geometry (Question 7, 8 and 9), still presents a problem, as many candidates struggle to answer these questions. The questions that were answered, were answered more thoroughly then in previous years.

SECTION 2: Comment on candidates' performance in individual questions

QUESTION 1 [12 Marks]

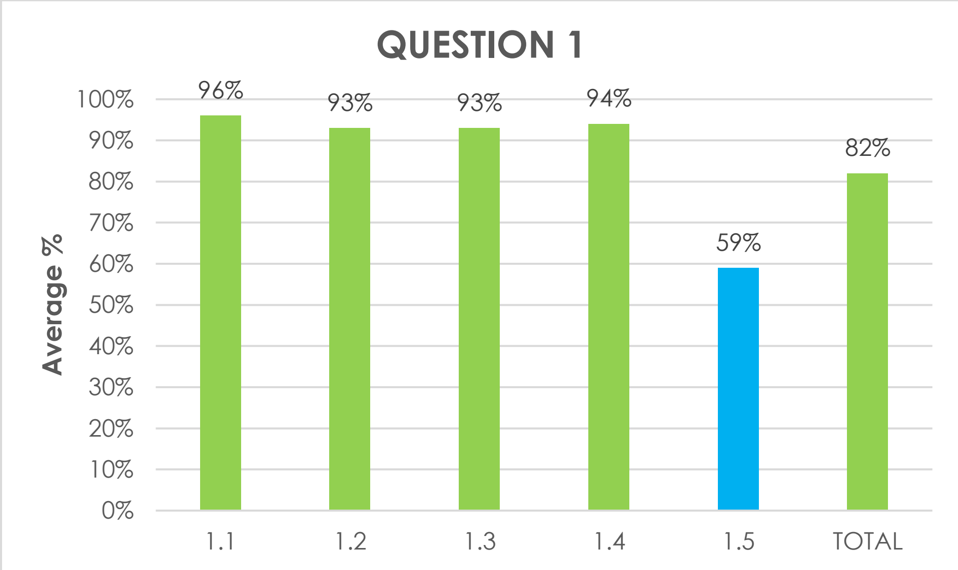
QUESTION 1

The diagram below shows ΔABC with vertices $A(6;0)$, $B(3;-1)$ and $C(4;-4)$.
CA is produced to form the angle of inclination, θ, with the positive x-axis.
M is the midpoint of CA.



1.1	Determine the gradient of AC.	(2)
1.2	Hence, determine the size of angle θ.	(2)
1.3	Determine the length of BC.	(2)
1.4	Determine the coordinates of M.	(2)
1.5	Determine the equation of the line through M, perpendicular to CA, in the form $y = \ldots$	(4) [12]

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?



- Question 1 was the best performing question in the question paper, not only for the 100 sampled candidates, but also for the remainder of the scripts.
- There is a significant improvement in the way the candidates answered Analytical Geometry from previous years.
- More candidates are answering the questions relating to Analytical Geometry and they are performing well in the question. This helps to improve the candidates overall mark for the question paper.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

i.) The most significant error that occurred in Question 1, was in the sub-question 1.5, were candidates were expected to determine the equation of a line perpendicular to another line and going through a certain point.

ii.) Many candidates were unable to find the correct gradient of the perpendicular line.

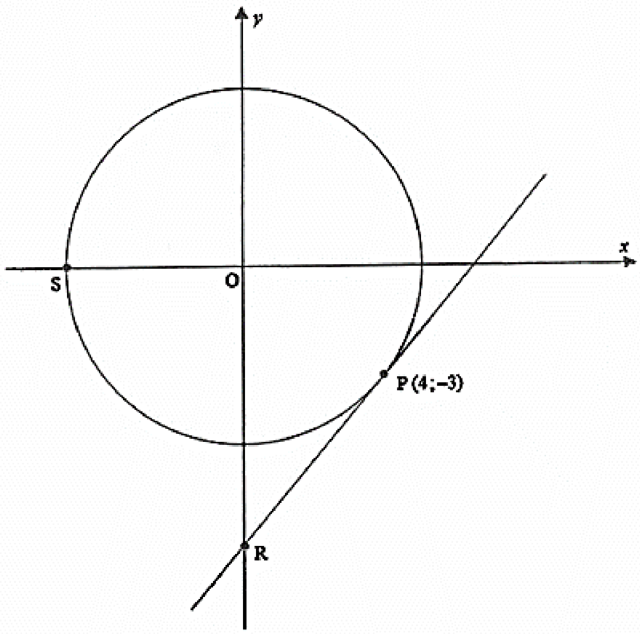
iii.) Candidates also substituted the incorrect point to be able to find the final equation of the perpendicular line.

(c) Provide suggestions for improvement in relation to Teaching and Learning. **(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.**
Educators should focus on the following during their contact time with candidates: i.) Emphasise basic rules of Analytical Geometry that was taught in Grade 10, but still plays a vital role in answering certain questions in Grade 12. For example, clearly distinguish between when are lines parallel and when they are perpendicular and how do you find the gradients of lines that are parallel or perpendicular. Educators must emphasise the basic rules for gradients: a. When gradients are equal, lines are parallel; b. When the product of two gradients equals -1, the lines are perpendicular and; c. When the gradients on a line are all equal, the points are co-linear. ii.) Educators must remember to do application questions with the candidates, w.r.t straight lines: a. How to find the equation of a line going through a specific coordinate/point; and b. How to find the equation of a line that is either parallel or perpendicular to another line.

QUESTION 2 [12 Marks]

QUESTION 2

2.1 In the diagram below, O is the centre of the circle defined by $x^2 + y^2 = r^2$
PR is a tangent to the circle at point P.
Point S is an x-intercept of the circle.
Point R is the y-intercept of line PR.

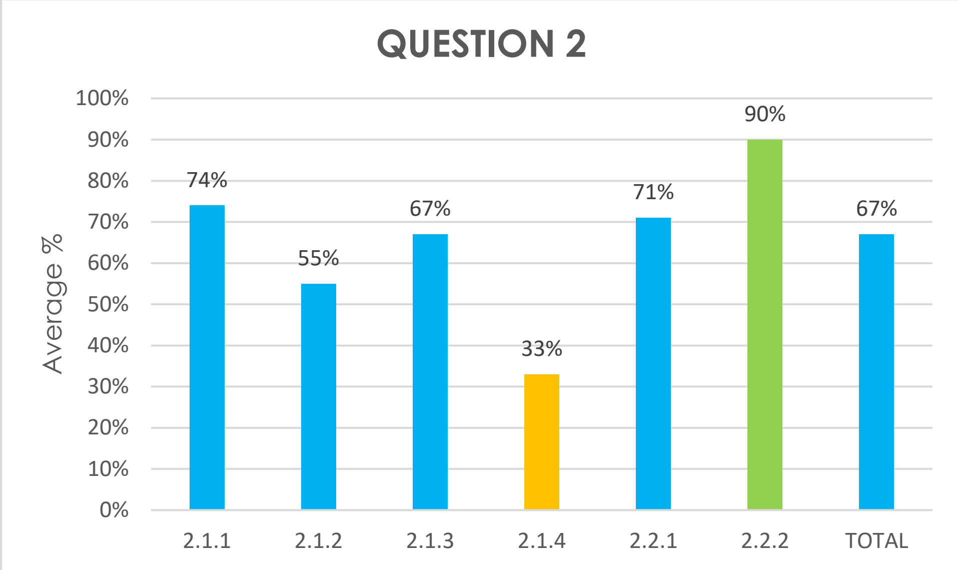


2.1.1	Determine the equation of the circle.	(2)
2.1.2	Write down the coordinates of S.	(2)
2.1.3	Determine the equation of the tangent in the form $y = \ldots$	(4)
2.1.4	Write down the y-coordinate of point R.	(1)

2.2 Given: $\frac{x^2}{1} + \frac{y^2}{9} = 1$

2.2.1	Express the equation in the form $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$	(1)
2.2.2	Hence, sketch the graph of the ellipse.	(2) [12]

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?



- Candidates struggled with writing down basic information like the y-intercept of a tangent line after the equation was calculated in the previous question (sub-question 2.1.4).
- Overall Question 2 was not too poorly answered and in most cases candidates scored 8 out of the maximum 12 marks.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

i.) Just like the cohort of 2023, candidates once again struggled to give the equation of a circle in its standard form. Candidates, continuously calculated the radius, instead of the equation of the circle.

ii.) Candidates struggled to calculate the equation of the tangent line, as they did not calculate the correct gradient. They calculated the gradient of the line OP (radius) and then used that to calculate the equation of the tangent line, instead of making use of the rule for perpendicular lines.

iii.) Candidates were unable to write the formula (sub-question 2.2.1) for the ellipse in its standard form ($\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$) and therefore this resulted in poorly sketching of the graph (sub-question 2.2.2) for the ellipse.

iv.) When it came to the standard form of the ellipse, many candidates wrote $x = 1$ and $y = 3$, instead of referring to the a- and b-values (i.e.: $a = 1$ and $b = 3$).

(c) Provide suggestions for improvement in relation to Teaching and Learning. **(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.**
Educators should focus on the following during their contact time with candidates: i.) Emphasise to candidates that they must always read the question carefully and make sure of what is being asked of them. Not reading the question completely results in unnecessary marks that are being lost due to them not giving the final answer that is expected in the question. ii.) Emphasise basic rules of Analytical Geometry that was taught in Grade 10, but still plays a vital role in answering certain questions in Grade 12. For example, clearly distinguish between when are lines parallel and when they are perpendicular and how do you show that lines are parallel or perpendicular. iii.) Educators must emphasise the basic rules for gradients: a. When gradients are equal, lines are parallel; b. When the product of two gradients equals -1, the lines are perpendicular and; c. When the gradients on a line are all equal, the points are co-linear. d. Emphasis must be placed on how the standard form of the ellipse must look ($\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$), so that it can aid in the sketching of the graph. If candidates are taught to write the values of a and b in their square form (i.e.: $\frac{x^2}{1}+\frac{y^2}{9}=1 \rightarrow \frac{x^2}{(1)^2}+\frac{y^2}{(3)^2}=1$), it will help to determine the scale that must be used to sketch the ellipse accurately. This will also help to determine whether the ellipse is horizontal or vertical.

QUESTION 3 [14 Marks]

QUESTION 3

3.1 Given: $A = \frac{17}{60}\pi$ rad and $B = 34°$

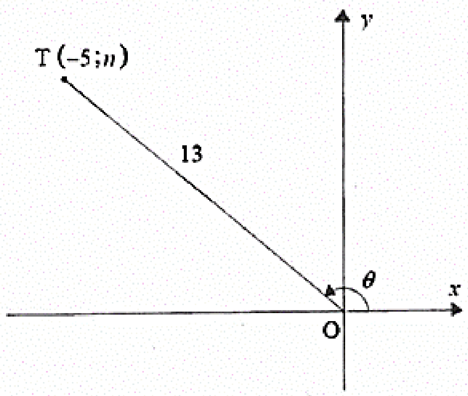
Use a calculator to determine the following:

3.1.1 Convert $\frac{17}{60}\pi$ rad to degrees. (1)

3.1.2 $\sqrt{\text{cosec B}}$ (2)

3.1.3 $\tan(A + B)$ (2)

3.2 In the diagram below, $T(-5\,;\,n)$ is a point in a Cartesian plane. $OT = 13$ units and θ is an angle of inclination.



Without using a calculator, determine the value of the following:

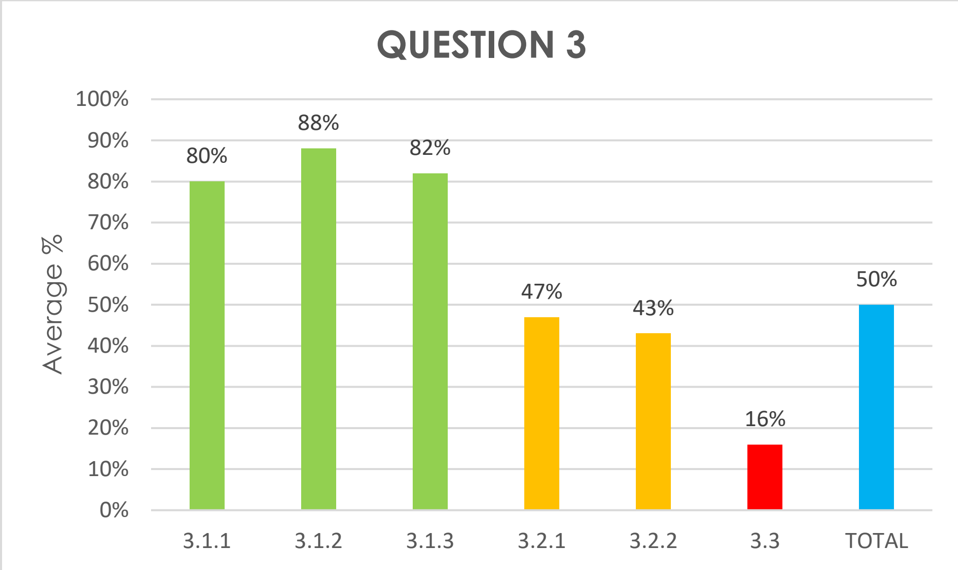
3.2.1 $\sec\theta$ (1)

3.2.2 $1 + \sin^2\theta$ (4)

3.3 Determine the value(s) of x if $2\sin x = 3\cos x$ for $x \in [180°\,;\,360°]$ (4)

[14]

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?



- More candidates were able to find the correct values, using their calculator, for sub-question 3.1.2 and sub-question 3.1.3.
- Candidates did however struggle with Question 3.2 (Trig ratios and the Cartesian Plane) and Question 3.3 (Solving for an unknown angle).
- Question 3.3, proved especially difficult for the candidates of 2024. Candidates struggled to apply the correct identity to be able to simplify the question, and hence calculate the correct value of the angle asked.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

i.) In Question 3.1 the most common error that occurred was candidates are mixing the different trigonometric ratios and their reciprocals.

ii.) In Question 3.2, candidates were given a ratio, which they needed to use to find the value of an expression. To do this, candidates needed to apply Pythagoras, which is a concept from Grade 8 and 9. This, however, proved problematic as candidates struggled to apply Pythagoras correctly as they struggle to identify which side is x, y or r (opposite, adjacent or hypotenuse).

iii.) Many candidates did not even attempt Question 3.3 and left the question unanswered. Some candidates who did attempt the question substituted the interval values for x instead of solving the equation.

(c) Provide suggestions for improvement in relation to Teaching and Learning.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

Educators should focus on the following during their contact time with candidates:

i.) Basic Grade 10 trig ratios must be revised and consolidated so that candidates know the ratios as well as their reciprocal ratios.

a. $cosec\theta = \frac{1}{sin\theta}$;

b. $sec\theta = \frac{1}{cos\theta}$ and;

c. $cot\theta = \frac{1}{tan\theta}$;

ii.) When doing questions on completing diagrams, emphasis must be placed on what is required to be done before the question can be answered.

a. If the diagram is given:

1. The triangle must be completed towards the x-axis.
2. All values of the triangle must be calculated. Ratio values cannot be given if all values have not been calculated.

b. If the diagram must be sketched by the candidate:

1. Trig equation given must be simplified so that the trig ratio is clear. i.e.: $3tan\theta - 1 = 0 \Rightarrow tan\theta = \frac{1}{3}$
2. Diagram should be drawn and completed in the correct quadrant using the sign (+ or –) of the ratio value.

c. Pythagoras is used to calculate the unknown values in the triangle diagram. This basic Grade 8 concept must be emphasised and consolidated even in Grade 12.

iii.) All forms of questions relating to solving trig equations must be practiced in class and given as homework. Educators cannot just do the basic examples of solving trig equations, more advanced equations must also be included in the classwork. Emphasis must be placed on answering the question. If the reference angle is calculated that does not mean that the question was answered. Classroom practice using and working with their CAST-diagram must be made a priority, to assist in solving trig equations.

2nd Quadrant	**1st Quadrant**
$\theta = 180^\circ - ref.<$	$\theta = ref.<$
SINE POSITIVE	**ALL POSITIVE**
180°	0°
180°	360°
TAN POSITIVE	**COSINE POSITIVE**
$\theta = 180^\circ + ref.<$	$\theta = 360^\circ - ref.<$
3rd Quadrant	**4th Quadrant**

QUESTION 4 [13 Marks]

QUESTION 4

4.1 Simplify the following:

4.1.1 $\sin(2\pi - x)$ (1)

4.1.2 $\cos(180^\circ - x)$ (1)

4.1.3 $\dfrac{\cot(180^\circ + x) \cdot \sin(2\pi - x)}{\cos(180^\circ - x) \cdot \cos(360^\circ - x) + 2\cos^2(180^\circ + x)}$ (6)

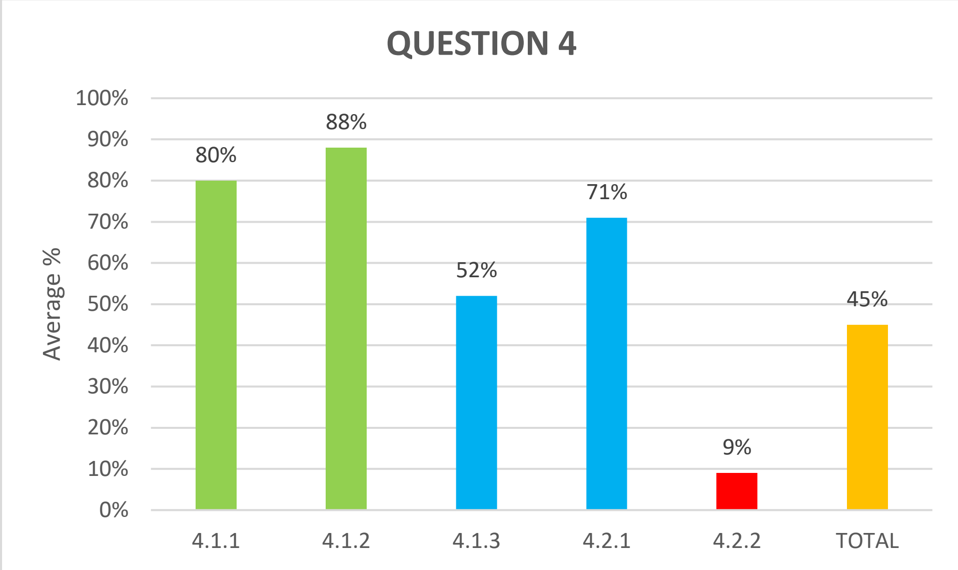
4.2 Answer the following questions:

4.2.1 Complete the identity: $1 - \sin^2\theta = ...$ (1)

4.2.2 Hence, prove that $\dfrac{1}{\sin\theta} - \dfrac{\sin\theta}{1 + \cos\theta} = \cot\theta$ (4)

[13]

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?



- The overall performance of Question 4 was slightly better than in 2023.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

i.) Candidates do not know their identities and reduction formulae and how to apply them in a question that is being asked. When working with the reduction formulae, candidates do not know in which quadrants to work to be able to simplify correctly.

ii.) Candidates are struggling to prove identities as they do not do the left and right part separately and they do not apply the identities they are taught correctly to be able to simplify.

iii.) When it comes to the simplification to prove the identities, candidates are struggling with the basic algebra behind the question. Candidates make the following mistakes:

a. i.e.: $\frac{1}{sin\theta} \times \frac{sin\theta}{cos\theta}$ will be simplified to $cos\theta$ instead of $\frac{1}{cos\theta}$.

b. i.e.: $\frac{1}{sin\theta} - sin\theta$ will be simplified to $\frac{1-sin^2\theta}{sin\theta}$ or candidates cancel the $sin\theta$ and end up with and answer of 0.

c. i.e.: $\frac{1}{sin\theta} - \frac{sin\theta}{1+cos\theta}$ will simply be written as one fraction, instead of finding an LCD for the expression and then only apply simplification.

iv.) i.e.: candidates apply cross multiplication for fractions that are being added or subtracted, hence an expression like $\frac{1}{sin\theta} - \frac{sin\theta}{1+cos\theta}$ ends up being an incorrect expression of $1(1 + cos\theta) - sin\theta(sin\theta)$.

(c) Provide suggestions for improvement in relation to Teaching and Learning.

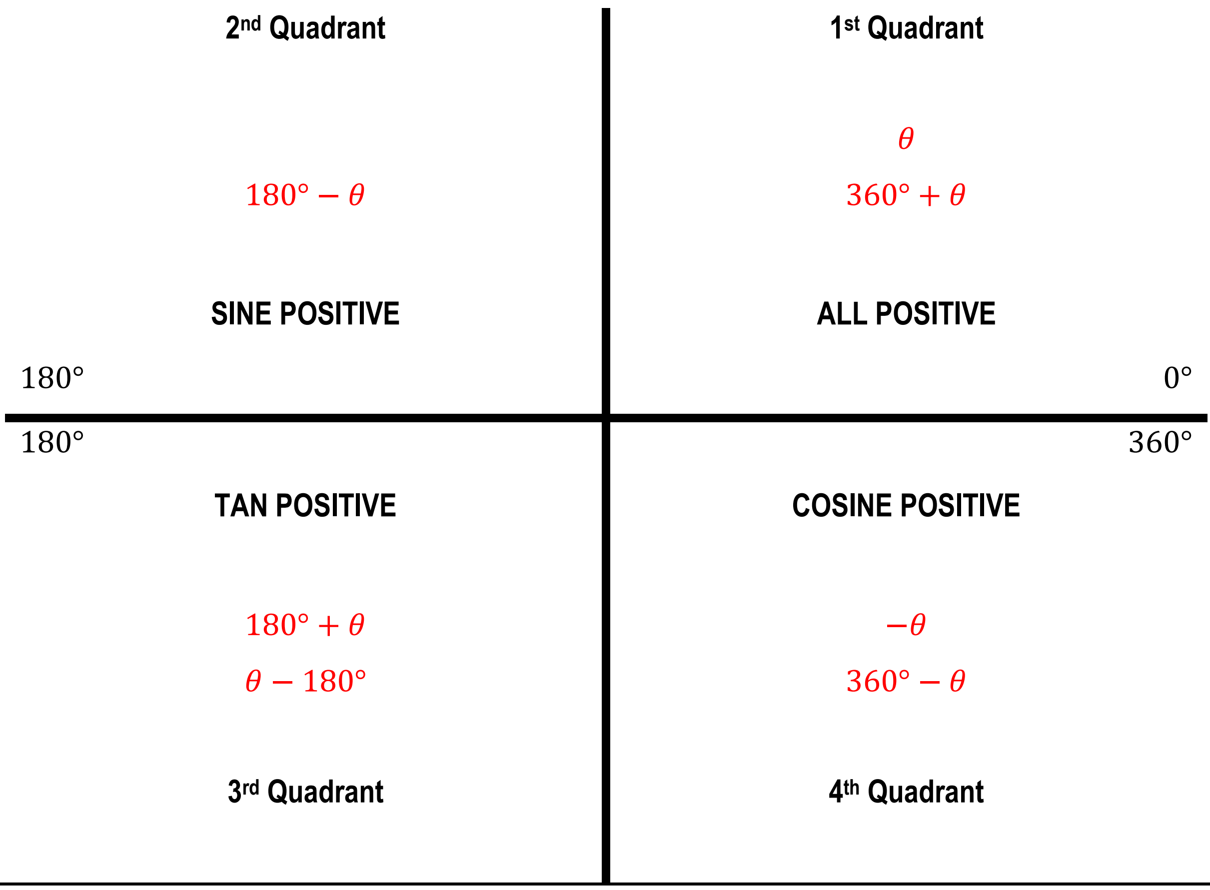
(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

Educators should focus on the following during their contact time with candidates:

i.) Candidates must know all the square identities. They must know how to change the subject of these identities to recognise, use and apply them in their calculations.

a. $sin^2\theta + cos^2\theta = 1$ 1. $sin^2\theta = 1 - cos^2\theta$ 2. $cos^2\theta = 1 - sin^2\theta$	b. $tan\theta = \frac{sin\theta}{cos\theta}$ OR $tan^2\theta = \frac{sin^2\theta}{cos^2\theta}$
c. $tan^2\theta + 1 = sec^2\theta$ 1. $tan^2\theta = sec^2\theta - 1$ 2. $1 = sec^2\theta - tan^2\theta$	d. $cot\theta = \frac{cos\theta}{sin\theta}$ OR $cot^2\theta = \frac{cos^2\theta}{sin^2\theta}$
e. $cot^2\theta + 1 = cosec^2\theta$ 1. $cot^2\theta = cosec^2\theta - 1$ 2. $1 = cosec^2\theta - cot^2\theta$	

ii.) Candidates must practice enough problems containing reductions on a regular basis, as these are easy marks to score if they are applied correctly. The CAST-diagram can assist in applying the reductions easily.



iii.) A clear connection must be made between Algebra and Trigonometry. Educators must emphasise that even though the question is on simplifying a Trigonometry Ratio or Proving Identities, in many instances there is Algebra involved in order to simplify to the correct answer.

a. When adding or subtracting fractions, one needs to find an LCD
b. When multiplying fractions, the basic rule is to multiply the numerators together and then multiply the denominators together and to then simplify if possible.
c. When dividing fractions, the basic rule is to multiply with the reciprocal.
d. There can be made use of factorisation to simplify expressions
e. Like terms can be added or subtracted

QUESTION 5 [12 Marks]

QUESTION 5

Given the functions defined by $f(x) = \tan x$ and $g(x) = \sin 2x$ for $x \in [0°; 180°]$

5.1 Sketch the graphs of f and g on the same set of axes on the grid provided. Clearly indicate ALL the asymptotes, intercepts with the axes and turning points. (6)

5.2 Use your graphs to write down the following:

5.2.1 The period of g (1)

5.2.2 TWO values of x for which $f(x) = g(x)$ (2)

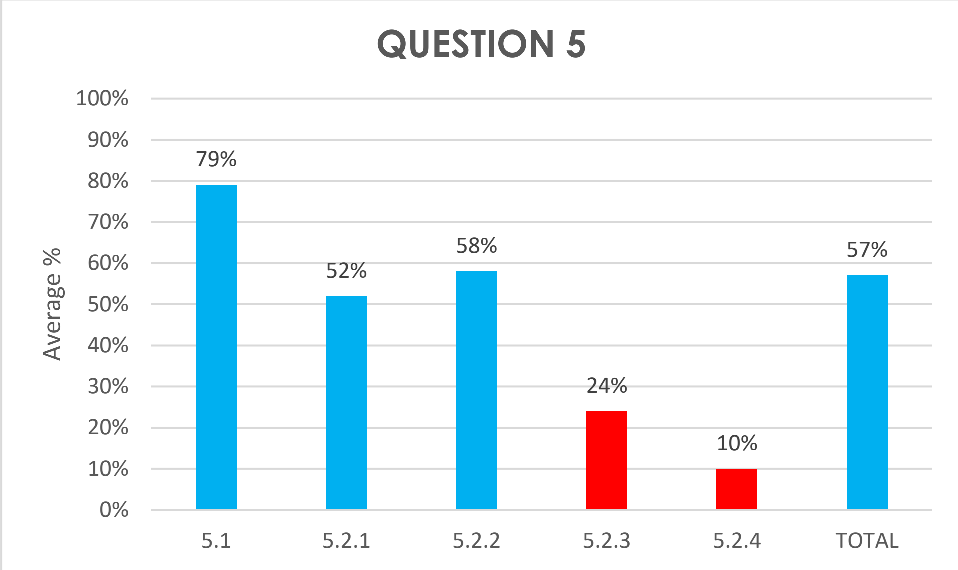
5.2.3 The amplitude of $2g(x)$ (1)

5.2.4 The resultant (new) equation h, if:

- The period of g is halved, and
- The range is $-5 \leq y \leq 5$ (2)

[12]

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?



- Question 5 performed better than last year, as in the 2024 paper candidates were asked to sketch graphs, instead of just interpreting graphs like in 2023.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

i.) Candidates gave the period of an original sine-graph instead of giving the changed period of the graph that has undergone a period change.

ii.) Some candidates who did manage to get the correct value of the period, wrote it as an interval, instead of a single value.

iii.) In sub-question 5.2.2 candidates struggled to read the correct values from the graphs, indicating where the graphs were equal. Hence, candidates are struggling to find values for x, when a specific restriction is given.

iv.) Candidates are struggling to give basic information of graphs if changes have been made to the graphs and they are no longer working with the graphs given or the original graphs.

(c) Provide suggestions for improvement in relation to Teaching and Learning.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

Educators should focus on the following during their contact time with candidates:

i. – iii.) Candidates must be reminded that the period of a graph is a single value in degrees and that the amplitude of a graph is a single positive value. Clearly distinguish the difference between the domain and period of a function and again range and domain as well.

a. Candidates could perhaps be taught to distinguish between the domain and the range they must follow the alphabet, i.e.: $\boldsymbol{D}$ comes before $\boldsymbol{R}$ and $\boldsymbol{x}$ comes before $\boldsymbol{y}$. So therefore the domain and x-values goes together and the range and y-values goes together.

b. Educators must emphasize the fact that changes to the trig graphs can be represented by any letter of the alphabet, as it is only a variable and can represent any value needed. For example:

1. In the CAPS Document the graphs are represented as follows:
   $y = ksinx$ or $y = kcosx$ or $y = \sin(kx)$ or $y = \cos(kx)$
2. In the 2021 Examination Guidelines the graphs are represented as follows:
   $y = asinx$ or $y = acosx$ or $y = \sin(ax)$ or $y = \cos(ax)$

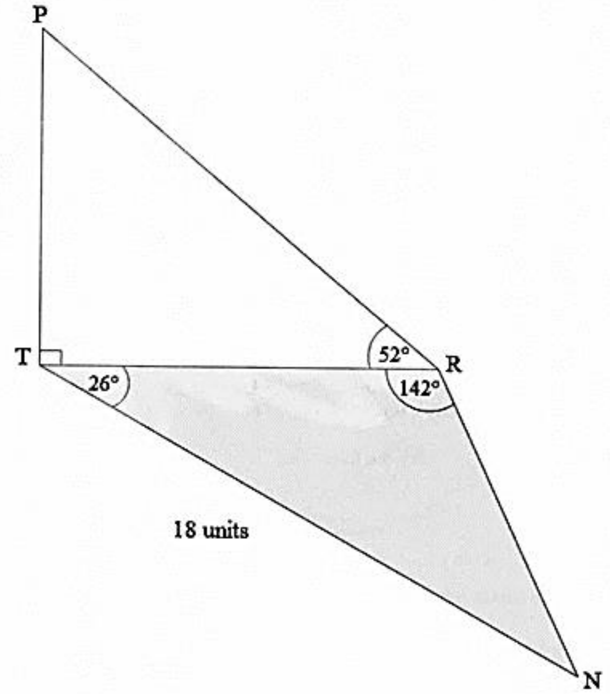
iv. – vi.) Interpretation of graphs must be constantly incorporated in graph revision worksheets and again emphasis must be placed on notation and wording.

- i.e.: $2g(x)$ means to multiply the whole graph by two and this will then influence the amplitude of the graph.
- i.e.: $g(2x)$ means that the period of the graph is being changed, so hence the new period for this graph will be either $\frac{360°}{2}$, if it is a sine- or cosine-graph, or it will be $\frac{180°}{2}$, if it is a tangent graph.
- $g(x) \pm 1$ means that the graph is being shifted up or down and that again the amplitude will be influenced.
- $g(x \pm 30°)$ means that the graph is being shifted left or right.

QUESTION 6 [11 Marks]

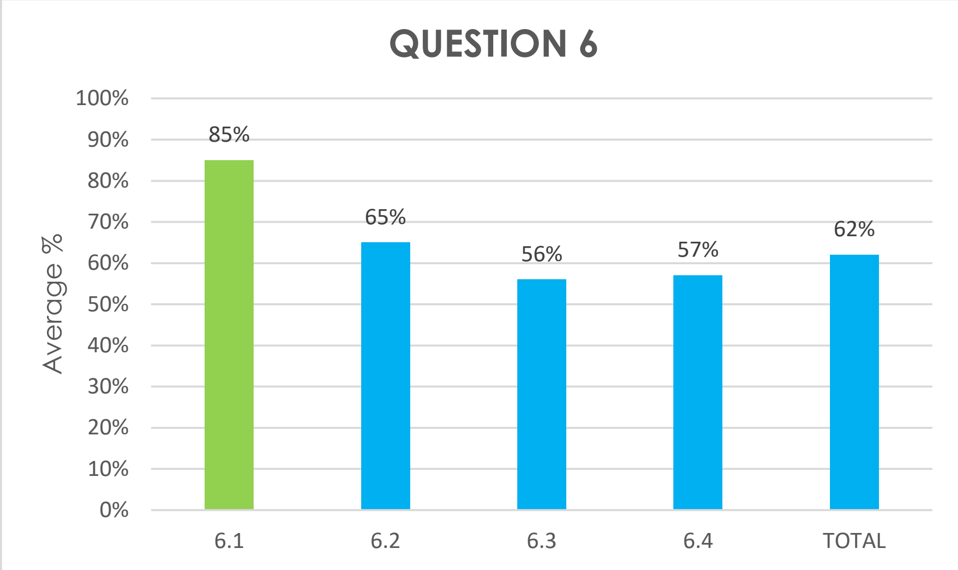
QUESTION 6

In the diagram below, T, R and N are points in the same horizontal plane.
$PT \perp TR$
The angle of elevation of P from R is $52°$.
$R\hat{T}N = 26°$ and $T\hat{R}N = 142°$
$TN = 18$ units



6.1	Write down the size of angle N.	(1)
6.2	Determine the length of TR.	(3)
6.3	Hence, determine the length of PT.	(2)
6.4	Determine: $\dfrac{\text{Area of } \Delta TRN}{\text{Area of } \Delta PRT}$	(5)
		[11]

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?



- The overall performance of Question 6 is better than in 2023, but there is still a lack of understanding the 3D Trig.
- Some candidates performed very poorly, while others did very well in this question.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

i.) Candidates struggled to choose the correct formula. They mixed up the formulae and used cosine-rule when they were supposed to use sine-rule or they tried to use the basic trig ratios.

ii.) Candidates also struggled to choose the correct angles and lengths to substitute into the formula.

(c) Provide suggestions for improvement in relation to Teaching and Learning.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

Educators should focus on the following during their contact time with candidates:

i.) Candidates must be taught how to decide which formula (cosine or sine rule) to select.

a. Conditions for the use of the Sine Rule:

1. Two sides and a non-inclusive angle
2. Two angles and one side

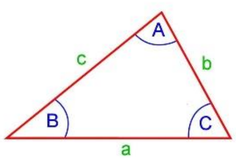
b. Conditions for the use of the Cosine Rule:

1. Two sides and an inclusive angle
2. Three sides

c. Condition for the use of the Area Rule:

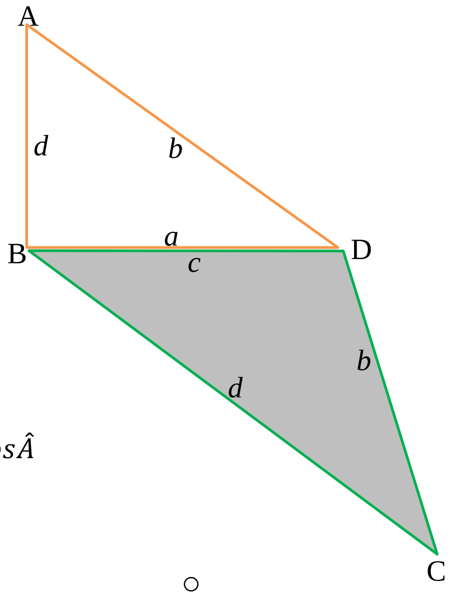
1. Two sides and an inclusive angle

ii.) Candidates must be taught which angle goes with which side in a specific triangle.



In ΔABC:
$\frac{sin\hat{A}}{a} = \frac{sin\hat{B}}{b} = \frac{sin\hat{C}}{c}$
OR
$\frac{sin\hat{A}}{BC} = \frac{sin\hat{B}}{AC} = \frac{sin\hat{C}}{AB}$

$a^2 = b^2 + c^2 - 2bc.cos\hat{A}$
OR
$BC^2 = AC^2 + AB^2 - 2AC.AB.cos\hat{A}$



In ΔABD:
$\frac{sin\hat{A}}{a} = \frac{sin\hat{B}}{b} = \frac{sin\hat{D}}{d}$
OR
$\frac{sin\hat{A}}{BD} = \frac{sin\hat{B}}{AD} = \frac{sin\hat{D}}{AB}$

$a^2 = b^2 + d^2 - 2bc.cos\hat{A}$
OR
$BD^2 = AB^2 + AD^2 - 2AB.AD.cos\hat{A}$

In ΔBCD:
$\frac{sin\hat{B}}{b} = \frac{sin\hat{C}}{c} = \frac{sin\hat{D}}{d}$
OR
$\frac{sin\hat{B}}{CD} = \frac{sin\hat{C}}{BD} = \frac{sin\hat{D}}{BC}$

$b^2 = c^2 + d^2 - 2cd.cos\hat{B}$
OR
$DC^2 = BD^2 + BC^2 - 2BD.BC.cos\hat{B}$

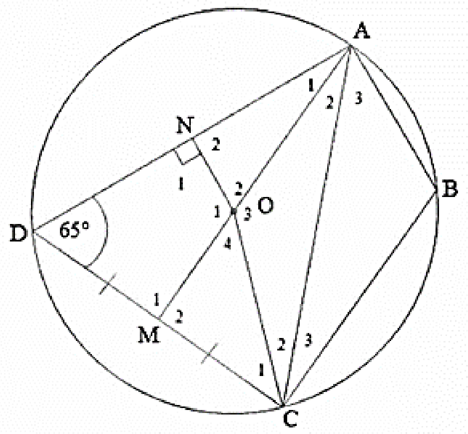
QUESTION 7 [12 Marks]

QUESTION 7

In the diagram below, O is the centre of circle ABCD.
AOM is a straight line.
M is the midpoint of chord DC.

ON ⊥ AD

$\hat{D} = 65°$



7.1 Write down the reason why $\hat{M}_1 = 90°$ (1)

7.2 Hence, write down the reason why DMON is a cyclic quadrilateral. (1)

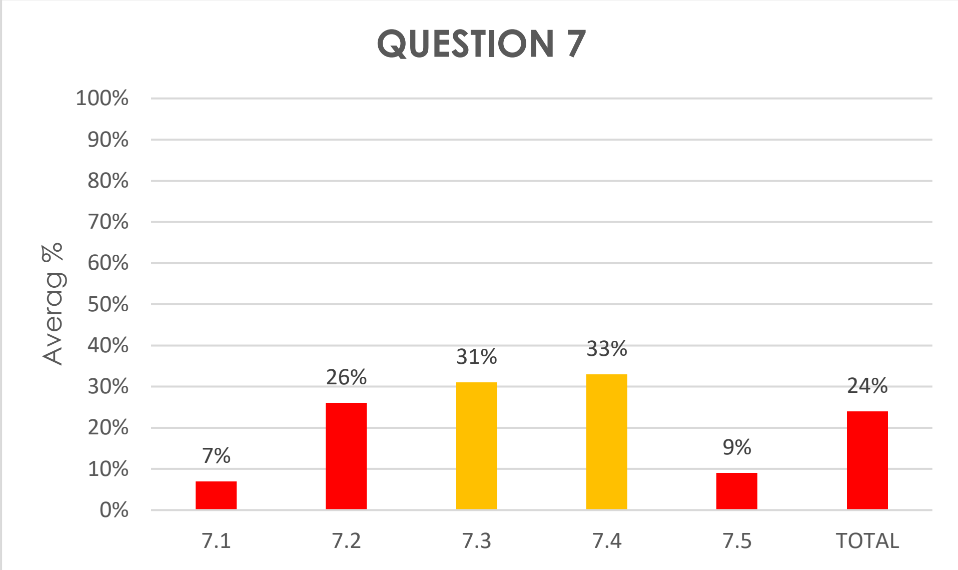
7.3 Complete the following table:

STATEMENT	REASON	
$\hat{O}_1 = ...$	Opposite ∠s of cyclic quad	(1)
$\hat{B} = ...$	Opposite ∠s of cyclic quad	(1)
DN = ...	...	(2)

7.4 Prove that Δ ADM ≡ Δ ACM, stating reasons. (3)

7.5 Show, with reasons, that AOCB is not a cyclic quadrilateral. (3)
[12]

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?



- Question 7 was the worst performing question in the question paper.
- The question was either answered very poorly by candidates or it was not answered at all.
- Even though the diagram was provided in the answer book to assist candidates in finding answers, they did not make use of the diagram provided.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

i.) Candidates struggle to provide reasons for certain calculations or as to why certain calculations can be done, to prove angles or to prove if quadrilaterals are cyclic quadrilaterals.

ii.) Overall, candidates struggle to provide reasons for their geometrical calculations.

iii.) Candidates are struggling to interpret the diagrams given and to properly utilise the answer book and the diagrams there in to help them make conclusions and calculate angles correctly.

(c) Provide suggestions for improvement in relation to Teaching and Learning.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

Educators should focus on the following during their contact time with candidates:

ii.) Emphasis must be placed on completing a theorem statement – these questions are classified as level 1 questions – use the proper reasons as provided by the Examination Guidelines. Knowing your theorems are the first path to success to Euclidean Geometry and identifying the applicable theorem in a diagram.

iii.) When the question requires to determine the size of an angle, it means there must be value attach to the angle.

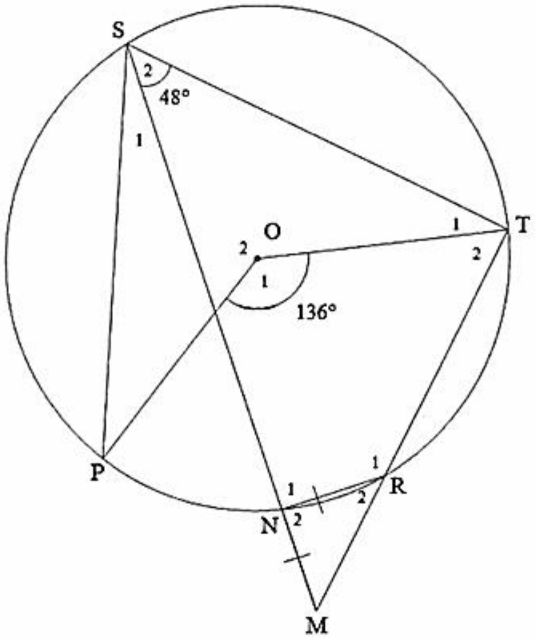
iv.) Assumptions cannot be made if they cannot be substantiated or proved.

v.) Teach candidates to "break-up" the diagram – in other words look for certain identifying diagrams that relate to the individual theorems – this means ample exercises for the eyes to get used to.

QUESTION 8 [15 Marks]

QUESTION 8

8.1 In the diagram below, O is the centre of circle PSTRN.
Chords TR and SN are extended to meet at M such that NM = NR.
$\hat{O}_1 = 136°$ and $\hat{S}_2 = 48°$



Determine, stating reasons, the size of EACH of the following angles:

8.1.1 $\hat{S}_1$ (3)

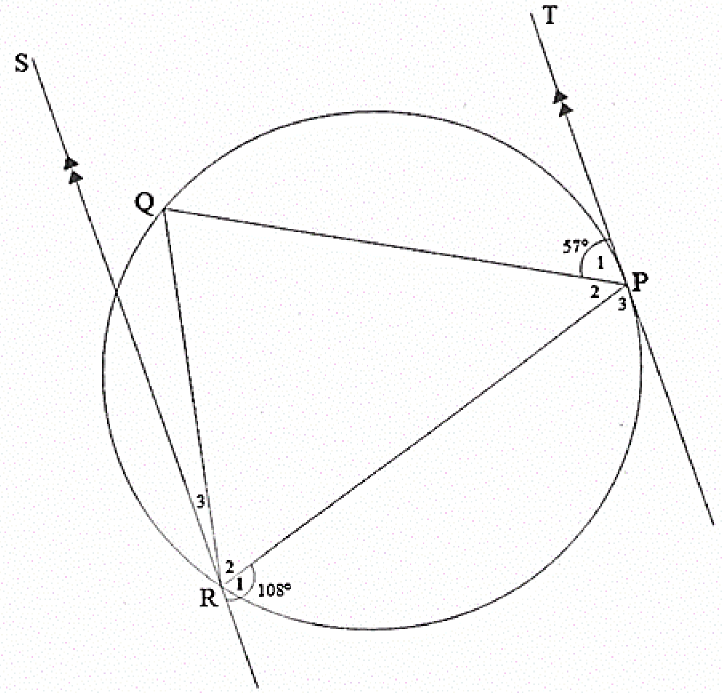
8.1.2 $\hat{N}_2$ (6)

8.2 In the diagram below, PT is a tangent to circle PQR at P.

SR is drawn so that RS || PT

$\hat{P}_1 = 57°$

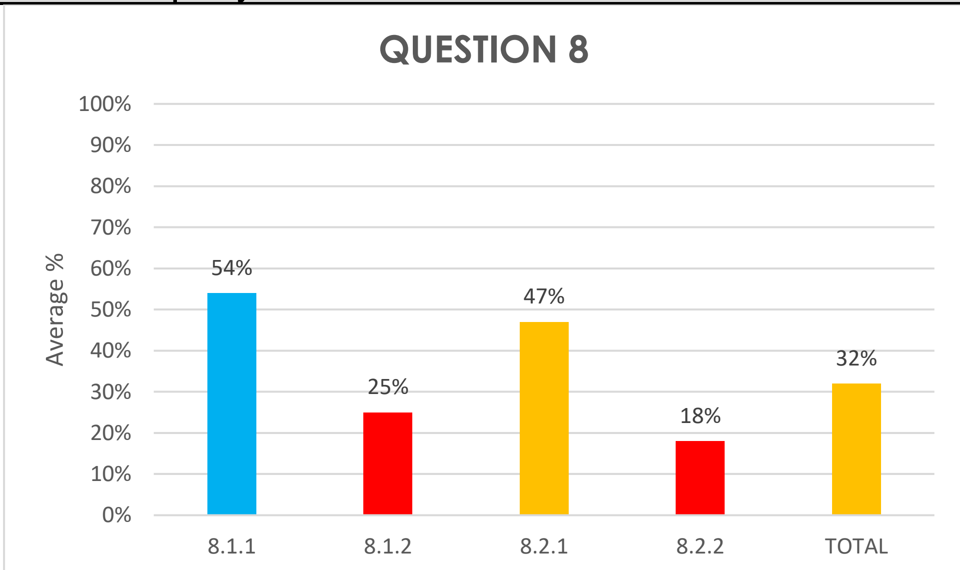
$\hat{R}_1 = 108°$



8.2.1 Determine, stating reasons, the size of $\hat{R}_2$. (2)

8.2.2 Show, stating reasons, that $\hat{Q} = S\hat{R}P$ (4)
[15]

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?



- After Question 7, Question 8 was the next poorly answered question.
- Again a major problem in the question is the giving of the correct reasons.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

i.) Candidates are leaving out reasons for angles calculated or giving incorrect reasons that are not acceptable. This is specific to the Circle Geometry done in Grade 11.

ii.) Candidates are not using correct notation when naming angles. i.e.:

a. When needing to state $\widehat{M}_1 = \widehat{M}_2$ they simply say $M = M$;

b. Instead of $P\hat{S}T$ or $\hat{S}_1 + \hat{S}_2$ they just refer to it as $\hat{S}$.

(c) Provide suggestions for improvement in relation to Teaching and Learning.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

Educators should focus on the following during their contact time with candidates:

i.) Educators must ensure that candidates only make use of the acceptable reasons as they are stated in the Examination Guidelines for Technical Mathematics of 2021. Perhaps the acceptable reasons can be copied for candidates so that they can paste it in their workbooks and use it while doing classwork, homework or studying for tests/exams.

ii.) Candidates must be taught how to name angles in a triangle and they need to be reminded that they need to be specific when it comes to the naming as there might be more than one angle in a triangle that can be linked to a certain letter.

iii.) Emphasis must be placed on completing a theorem statement – these questions are classified as level 1 questions – use the proper reasons as provided by the Examination Guidelines. Knowing your theorems are the first path to success to Euclidean Geometry and identifying the applicable theorem in a diagram.

iv.) When the question requires to determine the size of an angle, it means there must be value attach to the angle.

v.) Assumptions cannot be made if they cannot be substantiated or proved.

vi.) Teach candidates to "break-up" the diagram – in other words look for certain identifying diagrams that relate to the individual theorems – this means ample exercises for the eyes to get used to.

vii.) Euclidean Geometry can only be mastered if it is practiced continuously. Candidates must be taught how to transfer given information onto the diagram to assist them in answering given questions.

viii.) Diagrams should be analysed to assist in finding answers, in other words first try to look which theorems can possibly be used in order to find the answers to the questions being asked.

QUESTION 9 [11 Marks]

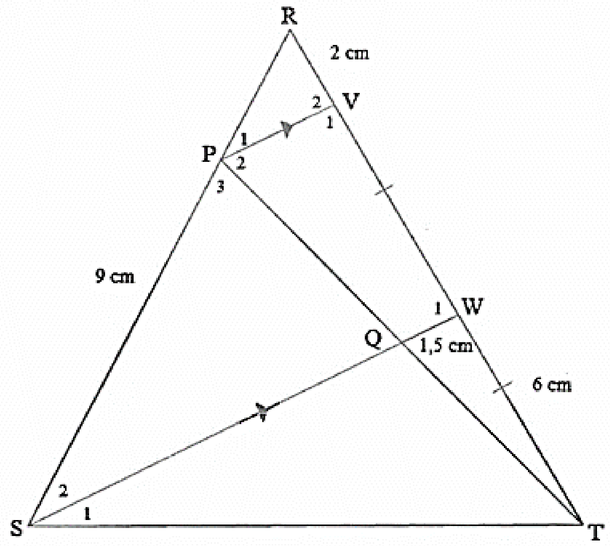
QUESTION 9

In ΔRST below, P is a point on RS. V and W are points on RT so that PV || SW.

PT and SW intersect at Q.

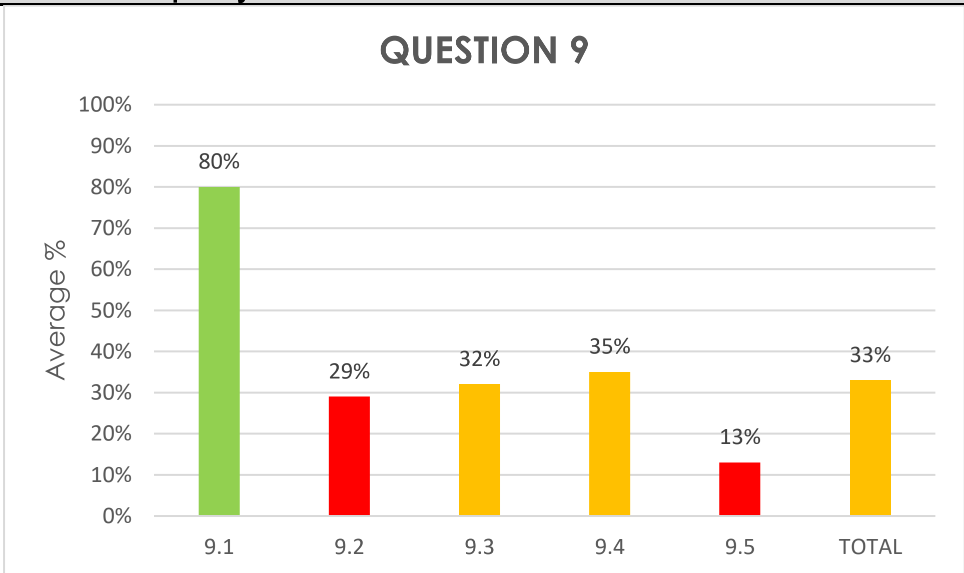
W is the midpoint of VT.

PS = 9 cm, WT = 6 cm, RV = 2 cm and QW = 1,5 cm



9.1	Write down the length of VW.	(1)
9.2	Hence, determine the length of RP, stating reasons.	(3)
9.3	Write down the length of PV, stating a reason.	(2)
9.4	Prove that Δ RPV ||| Δ RSW, stating reasons.	(3)
9.5	Hence, determine the length of SW.	(2) [11]

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?



- Candidates are struggling immensely with Euclidean Geometry as a whole. This includes the Grade 11 Circle Euclidean Geometry and the Grade 12 Triangle Euclidean Geometry.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

i.) Candidates struggled to give correct answers for Question 9 and did not quite understand the trend of the question. The candidates who managed to give the correct proportions and get the correct answer lost a mark as they did not give the complete reason.

   a. i.e.: Candidates either stated only "prop theorem" or gave the set of parallel lines instead of giving the two parts together for a complete reason (prop thm; $PV \parallel SW$).

ii.) Candidates are having a hard time giving the correct ratios when it comes to proportionality and are also not substituting the correct values into the ratio to find the answer to the questions that were asked.

iii.) Candidates are not going back to work done in previous grades when they revise for their Grade 12 examinations, for example something basic like Pythagoras, etc.

(c) Provide suggestions for improvement in relation to Teaching and Learning.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

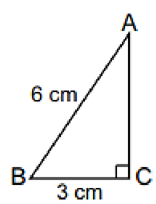
Educators should focus on the following during their contact time with candidates:

i.) Educators must ensure that candidates only make use of the acceptable reasons as they are stated in the Examination Guidelines for Technical Mathematics of 2021. Perhaps the acceptable reasons can be copied for candidates so that they can paste it in their workbooks and use it while doing classwork, homework or studying for tests/exams.

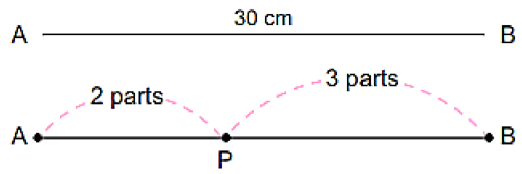
ii.) Proportionality Theorem:

- The proportionality theorem should be done in as many ways as possible to show candidates all the possible combinations of how sides can be written in proportion (ratios).
- Educators could try to explain the proportionality theorem in the following manner:
  - Start by explaining what a ratio is.
    - Ratios are used to compare two quantities of the same unit (kind).
  - Form basic ratios using shapes.
    - The ratio of $BC : AB = 3 : 6 = 1 : 2$
    - Ratios can also be written as fractions:

      $\frac{BC}{AB} = \frac{3}{6} = \frac{1}{2}$



- Then move on to show that a straight line can be divided into ratios.



  - Let $AP = 2k$ and $PB = 3k$, then $AB = 5k$

    $\therefore 5k = 30\ cm$

    $\therefore k = 6\ cm$

  - The length of $AP = 12\ cm$ and $PB = 18\ cm$
  - So therefore the ratio of $AP : PB = 12 : 18 = 2 : 3$
  - NOTE: $\frac{AP}{PB} = \frac{2}{3}$, so therefore $AP = \frac{2}{3}PB$

    BUT $\frac{AP}{AB} = \frac{2}{5}$, so therefore $AP = \frac{2}{5}AB$

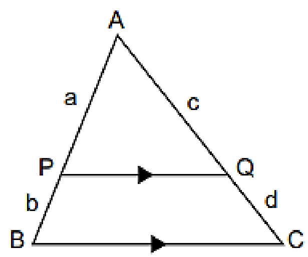
- This can now lead to the proportionality theorem because when two ratios are equal, e.g.: $\frac{AP}{PB} = \frac{AQ}{QC}$, we can say that AP, PB, AQ and QC are in proportion or that AP and PB are in proportion with AQ and QC.
- Hence, the proportionality theorem states that if a line, PQ, is drawn parallel to one side of a triangle, ABC, it divides the other two sides proportionally.
  - So if $PQ \parallel BC$, then $\frac{AP}{PB} = \frac{AQ}{QC}$
  - These proportions can be written in many ways:

    $\frac{AP}{PB} = \frac{AQ}{QC} \rightarrow \frac{PB}{AP} = \frac{QC}{AQ}$ OR

    $\frac{AP}{AB} = \frac{AQ}{AC} \rightarrow \frac{AB}{AP} = \frac{AC}{AQ}$ OR

    $\frac{PB}{AB} = \frac{QC}{AC} \rightarrow \frac{AB}{PB} = \frac{AC}{QC}$ OR

    $\frac{AP}{AQ} = \frac{PB}{QC}$ OR $AP.QC = PB.AQ$



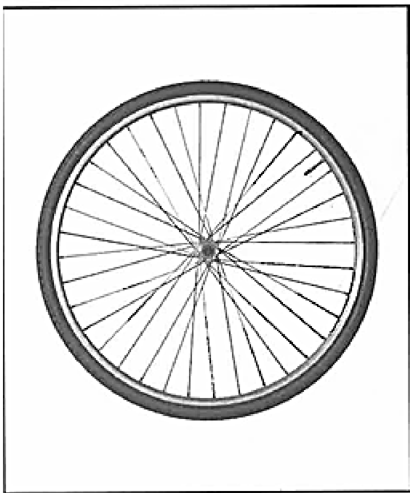
iii.) Emphasis must be placed on completing a theorem statement – these questions are classified as level 1 questions – use the proper reasons as provided by the Examination Guidelines. Knowing your theorems are the first path to success to Euclidean Geometry and identifying the applicable theorem in a diagram.

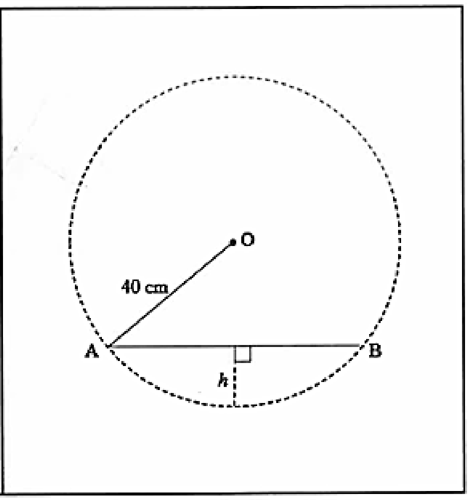
QUESTION 10 [20 Marks]

QUESTION 10

10.1 The picture and diagram below show a bicycle wheel. The diagram models the circular path of the rotating wheel.

- The radius of the wheel is 40 cm.
- AB represents a chord of the circle with centre O.
- h is the minor height of the segment in relation to chord AB.





If the wheel rotates at 48 revolutions per minute, answer the following questions:

10.1.1 Convert the rotation frequency of 48 revolutions per minute to revolutions per second. (1)

10.1.2 Write down the length of the radius of the wheel in metres. (1)

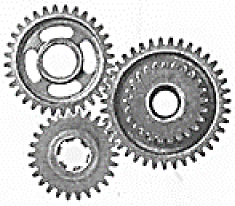
10.1.3 Hence, write down the length of the diameter in metres. (1)

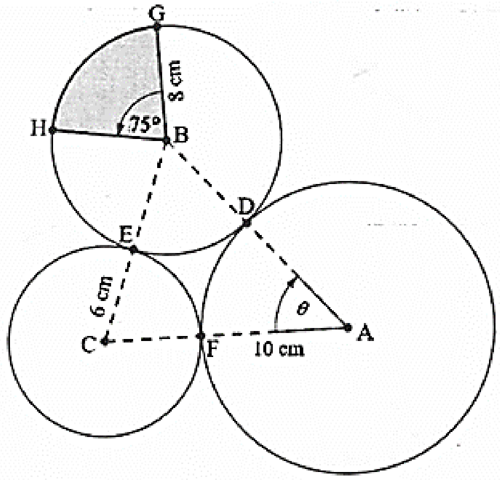
10.1.4 Hence, determine the circumferential velocity of a point on the circumference of the wheel, in metres per second. (3)

10.1.5 If it is further given that $h = 8$ cm, determine the length of AB in cm. (4)

10.2 The picture below shows 3 meshed gears. The diagram below the picture models this scenario.

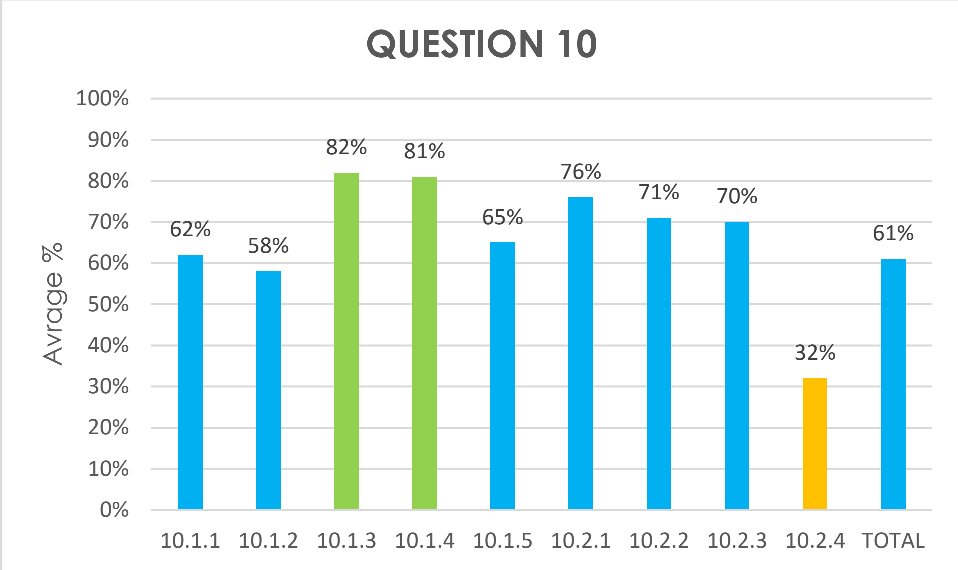
- The driver gear (centre A) has a radius of 10 cm, while the smaller gears (centre B and centre C) have radii of 8 cm and 6 cm respectively.
- The gears touch at points D, E and F.
- Points D, E and F lie on the sides of ΔABC.
- The shaded sector GBH has a central angle of $75°$
- Arc DF subtends a central angle of θ





10.2.1	Convert $75°$ to radians.	(1)
10.2.2	Hence, calculate the area of the shaded sector GBH.	(3)
10.2.3	Write down the length of AC	(1)
10.2.4	Determine the length of arc DF.	(5) [20]

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?



- In comparison with the sample candidates from 2023, this question made a quite an improvement in performance, with 61% of the candidates being able to answer the question in relation to 56% of candidates answering the question last year, in 2023.
- 10.2.4 was the poorest performing sub-question, as many could not determine the size of the angle using the given information and then further use the angle with the correct formula to determine the arc length. This was, however a Level 4 (Problem Solving) question.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

i.) Many candidates substituted the angle into the formula in degrees instead of radians and then did not convert so that the final answer is in radians/per minute.

ii.) Conversion between units still possess a problem for candidates as they could not do the basic conversions necessary for the questions.

iii.) Formulae were copied incorrectly form the information sheet or if they were copied correctly then they would leave some parameters out as they continue with the question.

iv.) Candidates substituted incorrect values into the formulae, i.e.: instead of substituting the diameter, they substitute the radius into the circumferential velocity formula or height of the segment formula.

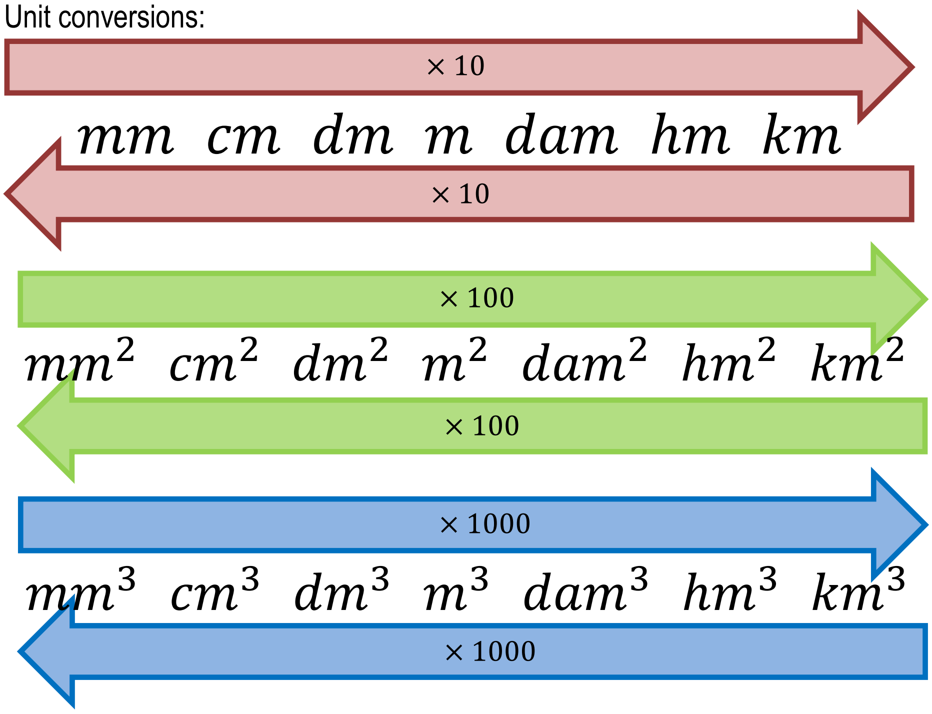
(c) Provide suggestions for improvement in relation to Teaching and Learning.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

Educators should focus on the following during their contact time with candidates:

i.) Basic conversions between different units (mm, cm, m, etc.); from Degrees to Radians or from Radians to Degrees, must be practiced in class to ensure candidates know these level 1 questions. Candidates cannot afford to lose marks because basic conversions cannot be done.

a. Unit conversions:



b. Radian/Degree conversions: $\pi \; radians = 180°$

- To convert, the easiest way to remember the conversion, is to use what you want as the answer (Degrees or Radians), as the numerator in your conversion fraction:
  i. i.e.: To convert from radians to degrees: $radians \times \frac{180°}{\pi}$
  ii. i.e.: To convert from degrees to radians: $degrees \times \frac{\pi}{180°}$

ii.) When using the formulae $s = r\theta$ and $Area = \frac{rs}{2} = \frac{r^2\theta}{2}$,the information sheet clearly states that the angle (θ) must be in RADIANS. Educators should emphasise this to candidates as to many loose a mark as the final answer is then not in the correct unit. All measurements must be in the same units – candidates must select a formula and not to use both.

iii.) Emphasis must be placed on formulae for circumferential and angular velocity. Candidates are using the incorrect formula in questions. Each unknown in the formula must be explained, so that candidates substitute the correct information into the formula to find the correct answer.

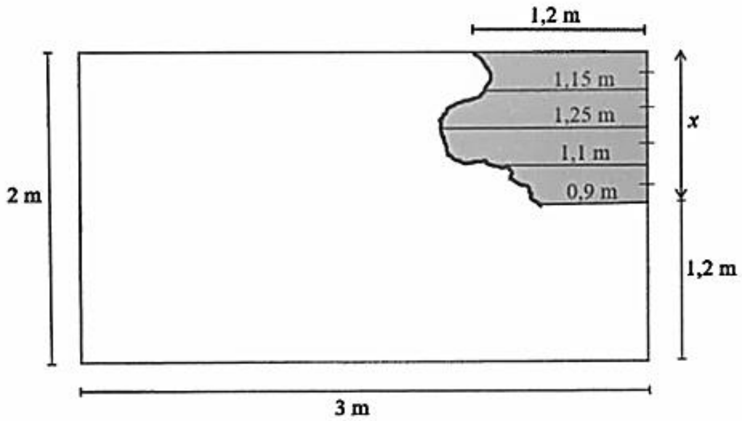
iv.) Problem solving questions in the context of Circles, Angles and Angular Movement should be done in class as part of the class work and not only focussed on during test or exam times. Incorporating these questions into classwork will help candidates become more comfortable with the questions and more of them will then attempt the questions in exams.

QUESTION 11 [18 Marks]

QUESTION 11

11.1 The diagram below models the picture of a wall with a shaded irregular plastered section.

- The dimensions of the wall: length = 3 m and width = 2 m
- The irregular plastered section has a straight side of x cm, divided into 4 equal parts, as shown.
- The ordinates dividing these parts are 1,2 m; 1,15 m; 1,25 m; 1,1 m and 0,9 m respectively.
- The length from the floor to the 0,9 m ordinate is equal to 1,2 m.



11.1.1 Determine the numerical value of x (1)

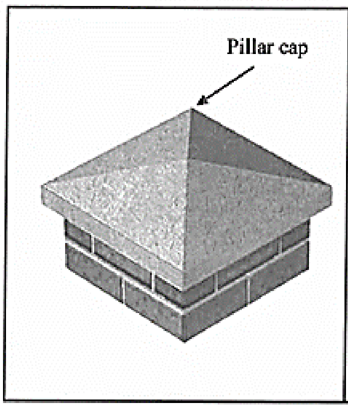
11.1.2 Hence, determine the width of each equal part. (1)

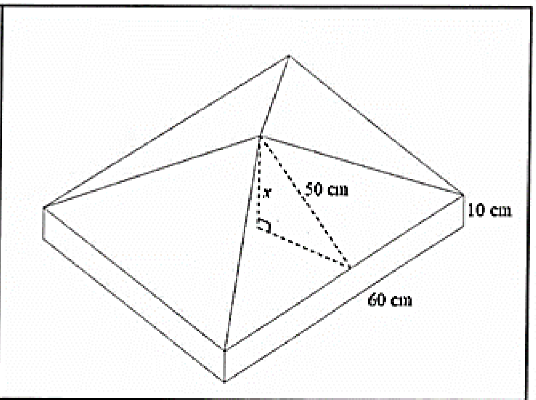
11.1.3 Hence, determine the area of the shaded irregular plastered section. (3)

11.1.4 Determine whether R1 700 will be sufficient to plaster the rest of the wall, if the cost for plastering, including material and labour, is R300 per square metre. (5)

11.2 The picture below shows a pillar cap that is placed on top of pillars of boundary walls. The diagram alongside models the pillar cap with the following dimensions:

- The pyramid section has a square base of lengths 60 cm by 60 cm and a slant height of 50 cm.
- The rectangular prism section has the same square base dimensions as the pyramid and a height of 10 cm.
- x cm represents the vertical height of the pyramid section.





The following formulae may be used:

Surface area of rectangular prism $= 2lb + 2lh + 2bh$

Volume of rectangular prism $= lbh$

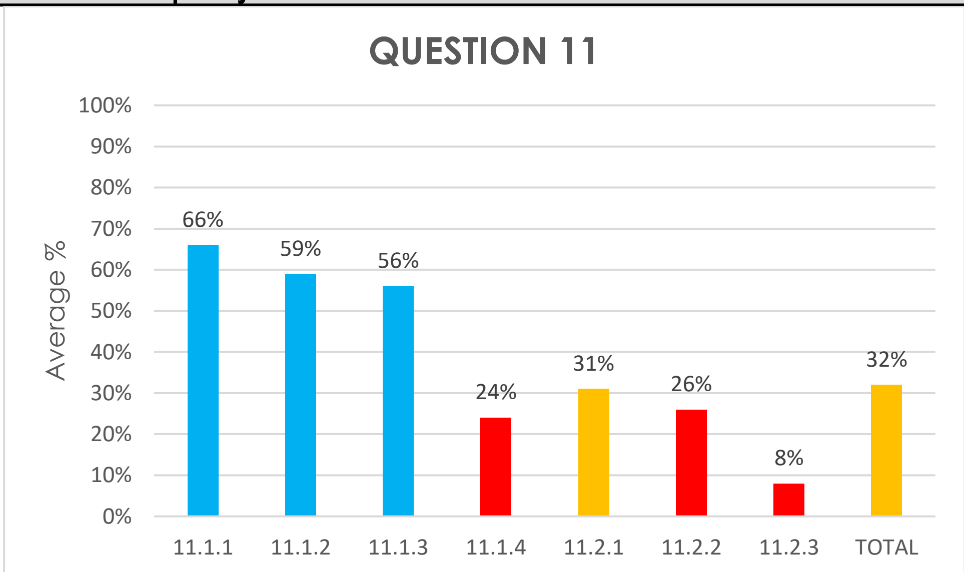
Volume of pyramid $= \frac{1}{3} \times$ Area of base $\times \perp$ height

11.2.1 Determine the surface area of the rectangular prism section of the pillar cap. **(3)**

11.2.2 Determine the value of x, the vertical height of the pyramid. **(2)**

11.2.3 Determine the total volume of ONE pillar cap. **(3)**
[18]

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?



- The performance in Question 11 is significantly lower than that of the 2023 cohort. Only 32% of the sampled candidates were able to answer the question in comparison to the 51% of the sampled candidates who were able to answer similar questions in 2023.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

i.) Candidates are copying formulae incorrectly from the information sheet that is provided or if they were copied correctly then they would leave some parameters out as they continue with the question.

ii.) When substituting the width of the equal parts learners use the number of equal parts instead of the width or they make use of the total length or any other random value.

  a. i.e.: $0{,}8$ or $1{,}1$ or $4{,}4$ or $1{,}2$ is substituted instead of $0{,}2$.

iii.) Candidates were not able to adapt the formula for the TSA of a rectangular prism, so that it was applicable to sub-question 11.2.1.

(c) Provide suggestions for improvement in relation to Teaching and Learning.

(d) Describe any other specific observations relating to responses of learners and comments that are useful to teachers, subject advisors, teacher development etc.

Educators should focus on the following during their contact time with candidates:

i.) Educators have to EMPHASISE the importance of copying formulae correctly from the information sheet. Also emphasise that formulae must not be changed unless necessary.

ii.) The application of the mid-ordinate rule must be done in all forms so that candidates get used to not only calculating the area itself, but they must be able to calculate any value that is given as an unknown – these are easy marks to get.

iii.) Expose candidates to more practical modelling problems, as in sub-question 11.1.4, 11.2.1 and 11.2.3.

OVERALL COMMENT
• The overall performance of the 2024 cohort was poorer than the cohort of 2023. Level 6 and 7 learners were still present in the cohort of 2024, but it is less than in 2023. There were however candidates who received ZERO for the question paper. • It is disheartening to see that there are also centres receiving ZERO percent pass rate and candidates achieving single digit totals in the question paper. • When using formulae, candidates must make sure the units are the same and that they correctly copy the formulae form the information sheet. • In most cases for Technical Mathematics the angles are in radians, especially in the topic Circles, Angles and Angular Movement as provided and mentioned on the information sheet. This must be emphasized so that candidates do not loose marks unnecessarily. • Understanding all the formulae on the formula sheet will be a big advantage to the candidates, so that they are able to identify the correct formulae to use in the questions. 8 Marks in this question paper was dedicated to simply choosing the correct formula from the information sheet, yet candidates could not do this and scored 0, where the minimum mark any candidate should have gotten was 8. • Educators must focus on practicing level 1 and 2 questions with their candidates as many could not even score marks in these questions. • Grade 11 work must also be thoroughly revised with candidates to ensure all marks asked on Grade 11 work can be scored. The Grade 12 curriculum for Technical Mathematics is structured in such a way that revision of previous grades work is definitely possible. • All questions must always be attempted by candidates as consistent accuracy marking ensures that marks can be given to candidate answers even if previous answers were completely wrong or incorrect. • No adjustments are required for this question paper, as the question paper was fair and on standard according to the CAPS document and Examination Guidelines.