Province of the
EASTERN CAPE
EDUCATION

EXAMINATIONS AND ASSESSMENT CHIEF DIRECTORATE

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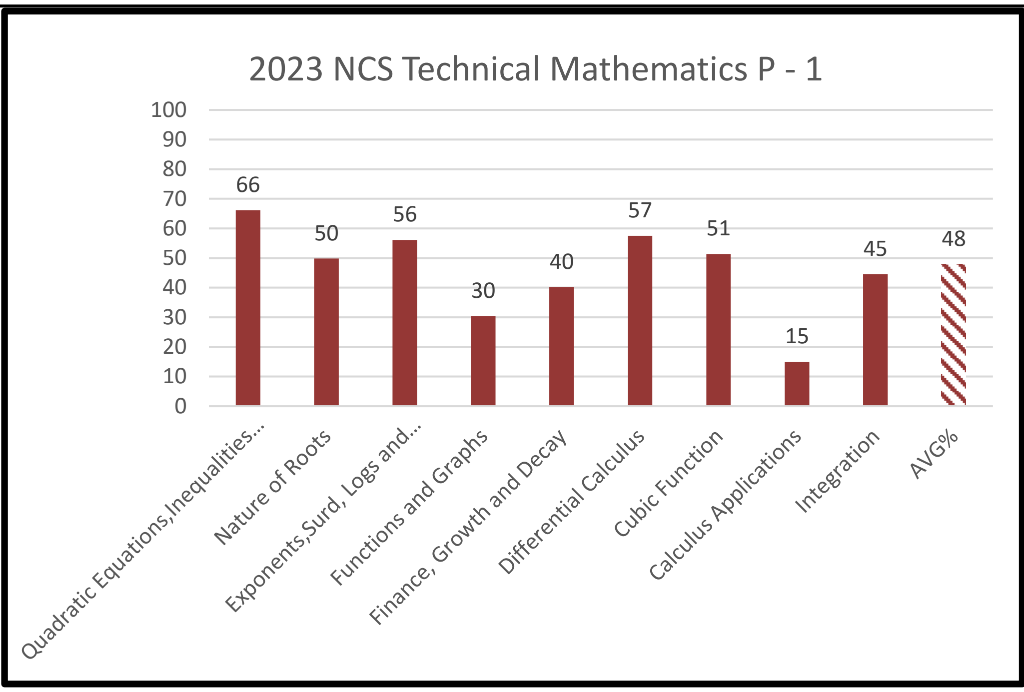
2023 NSC CHIEF MARKER'S REPORT

SUBJECT	**TECHNICAL MATHEMATICS**		
QUESTION PAPER	**1 X**	**2**	**3**
DURATION OF QUESTION PAPER	**3 hours**		
PROVINCE	**EASTERN CAPE**		

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

General misconceptions and errors committed by Candidates in the 2023 NSC Technical Mathematics Paper – 1:
• Incorrect use of a calculator. • Distributive errors evident on expanding expressions. • Incorrect copying of formulas from the formula sheets. • Ignoring instructions given for questions. • Interpretation abilities lacking. • Notational errors. • Simplification processes and steps lacking. • Confusing differentiation and integration. • Leaving brackets when substituting, leading to incorrect solutions. • Evidence of insufficient revision of the previous grade work, resulting to candidates loosing marks set from grade 10 or 11.
These errors that Candidates committed have been recurring for the past years examinations, an indicator that these must be taken into consideration by all the relevant officials in the line of teaching and learning of Technical Mathematics.



Question	Topic	Ave. performance %
1	Quadratic Equations and Inequalities, Binary Numbers	66%
2	Nature of roots	50%
3	Exponents, Surds and Logs, Complex numbers	56%
4	Functions and Graphs	30%
5	Finance, growth and Decay	40%
6	Differential Calculus	57%
7	Cubic Function	51%
8	Calculus applications	15%
9	Integration	45%
Total		**48%**

The graph above based on the 100 sampled scripts from 2760 shows the general performance of candidates at an average of 48%.

The candidates performed very well in Algebra, assessed in Q1 at an average above 60%.

The questions where candidates performed well at an average of 50% and above were Q 2, Q3, Q6, and Q7. These questions assessed Nature of Roots, Exponents, Surds, Logarithms and Complex numbers. Furthermore, Basic Calculus and Cubic Functions.

Finance, growth and decay as well as Integration, candidates performed at an average of 40% and above. These topics were assessed in Q 5 and Q 8 respectively.

The poorly performed question at an average of 30% assessed Functions and Graphs in Q 4.

The question on Calculus Applications, Q 8 was the worst performed questions at an average of 15%. This question involved measurement and optimization.

An observation made was that candidates performed poorly in questions involving higher order reasoning and interpretation. Questions involving problem solving were either poorly answered or not attempted at all.
There were candidates who failed to follow instructions as a result they lost marks specifically in Q7. Few candidates did not detach the answer sheet from the question paper where they were supposed to draw graphs for Q4.3 and Q7.5 and hand it in with their answer book.

SECTION 2: Comment on candidates' performance in individual questions

QUESTION 1

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

QUESTION 1

1.1 Solve for x:

1.1.1 $(7-3x)(-8-x)=0$ (2)

1.1.2 $3x^2-4x=\frac{1}{3}$ (correct to TWO decimal places) (4)

1.1.3 $-x^2+16>0$ (3)

1.2 Solve for x and y if:

$x-y=1$ and $x+2xy+y^2=9$ (6)

1.3 The diagram below shows an RCL circuit used for voltage magnification. The formula to determine the resonant frequency (f_r) of an RCL circuit is given below.

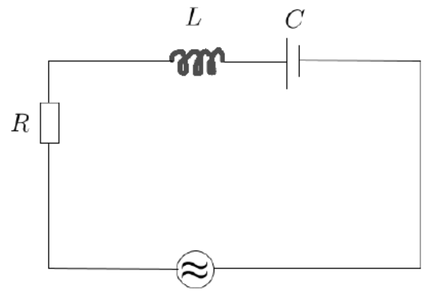


Diagram of RCL circuit

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

Where:

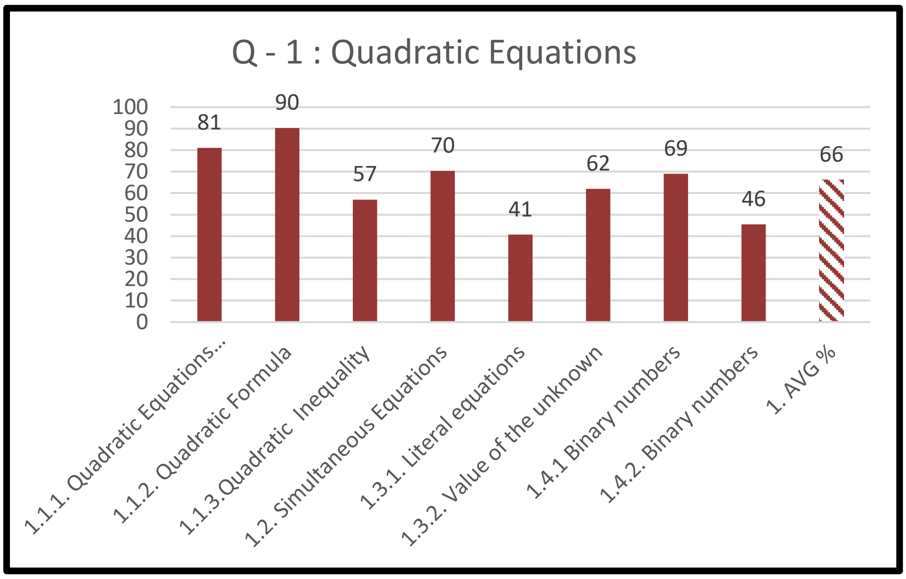
f_r = resonant frequency in Hz (hertz)
L = inductance in H (henry)
C = capacitance in F (farad)

1.3.1 Make L the subject of the formula. (3)

1.3.2 Hence, calculate the numerical value of L if $C = 0{,}65 \times 10^{-6}$ F and $f_r = 1{,}59\text{Hz}$ (2)

1.4 Express 24 as a binary number. (1)

1.5 Evaluate $144 \div 110_2$ and leave your answer as a decimal number. (2)
[23]



The graph above illustrates the average performance per sub question in Q 1. Q1 was well answered by candidates at an average of 66%. Candidates performed extremely well in Q1.1.1, Q 1.1.2 and Q1.2. Questions which assessed subject of the formula and a combination of binary and decimal numbers were fairly answered.

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

Q1.1.1 The quadratic equation is in **factor form**, but candidates expanded it, consuming much more time. In their act of expanding it they many came with incorrect quadratic equation because of distribution inability of the candidates. The solutions came incorrect and they lost all the two marks.

Q1.1.2 Candidates failed to transpose 1/3 and those who transposed did not the change the sign from

positive to negative, thus they use it as $c = \frac{1}{3}$ and they lost a mark for standard equation.

- Some Candidates transposed the denominator 3 and left the quadratic equation equal to 1.
- Candidates wrote the accurate quadratic formula incorrectly. They wrote it as $x = -b \pm \frac{\sqrt{b^2} - 4ac}{2a}$ or $x = \frac{-b \pm \sqrt{b^2} - 4ac}{2a}$ or $x = \frac{-b \pm \sqrt{4ac - b^2}}{2a}$
- Incorrect use of a calculator seemed prevalent with the Candidates Substitution was done correctly by some but the final answers were incorrect.
- Instructions indicated that the answers must be rounded to TWO decimal places but some candidates did not simplify their answers, they left it in surd form.

Q1.1.3. Candidates failed to correctly identify values for a, b and c which resulted in incorrect roots. Some candidates first divided the equation by negative sign but failed to reverse the inequality sign thus got the incorrect notation. Many candidates wrote incorrect notation $x > -4$ or $x < -4$

Q1.2 Transposition errors led to incorrect third equation.

$x - y = 1 \ldots..(1)$
$x = 1 - y$ or $-y = 1 - x$ and substitute with $-y$ in the place of y

- The standard form was mostly incorrect with most candidates because of the challenge of distribution. That led to the incorrect standard form.
- In $2(1 + y)\,y$ they wrote $2 + 2y + y$
- Most candidates that had the standard form equation in terms of *y* solved for x when using the quadratic formula. This made them get swapped values for x and *y*. This made them lose marks. .

Q1.3 Literal equations posed a lot of challenges for the Candidates. Many could not make L the subject of the formula correctly and so lost those marks.

- Solving a surd equation by squaring both sides was not perfected by Candidates. They simply removed the root sign without doing anything and continues solving the equation.

Q1.4 Some Candidates managed to use the ladder method to change the decimal 24 to binary but failed to write it correctly. They wrote 00011 instead of 11000.

(c) Provide suggestions for improvement in relation to Teaching and Learning
1.1.1 The key CFS – BODMAS – ERS for solving Quadratic Equations and Inequalities is very important in trying to make the entire question 1 routine. • Candidates in solving quadratic equations must start by checking the type of an equation given to them. This must be done in an orderly manner by testing for the easy to solve first,

which is C – Common Factor form. If the equation does not have a common factor then they must test check if it is in factor form – F or Standard form – S or has Brackets – B or the variable being solved is in the denominator – D or there is anything to be transposed – A or S or the variable is at the exponent – E or there is a radical – R and Simultaneous Equations – S. This order can help Candidates know the type of a quadratic equation and their disposal and so can apply appropriate method to solve it.

- Candidates should be exposed to different forms of quadratic equation representation and methods of solving them. Correct use of calculators should be encouraged, and these be utilized during the teaching and learning process where necessary.

1.1.2 Training Learners on solving equations that require transposition is very vital in Technical Mathematics. This should not only be done during revision sessions but must be done throughout the year as all TMAT questions will always require transposition abilities. It should be treated as a separate sub topic that needs to be tested regularly throughout.

- Formula sheets need not be given to candidates during examinations only. They should be having formula sheets pasted in their notes books and must be utilized all the time. This will help candidates get used to the use, selection and copying of the correct formula from the formula sheet.
- Informal assessments where Candidates are required to write different formulas prescribed for Technical Mathematics must be done. In that way Learners will be used to writing the formulae correctly.
- The use of quadratic formula in Grade 12 is encouraged from the beginning of the year but Learners must be exposed to various types of quadratic equations. Where a binomial is presented to the candidate to solve, they must make it a trinomial so that it resembles the general quadratic equation. Should.
- Candidates to always check if the quadratic equation or inequality has the required number of terms and be able to spot when a term is missing and to know which value to put thereof like in $-x^2+0x+16$ where $a=-1,\ b=0,\ c=16$

1.3 Teachers should drill Candidates on the use of correct notation. Explain thoroughly what it means when the solution lies between the two critical values, the use of "and", [ ], "or",( )

- Graphical interpretation of the solution sets must be emphasized during teaching of inequalities.

Candidates be made aware the variable in their quadratic equation must be made the subject of the formula in the quadratic formula: In $3y^2+3y-8=0$ then $y=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$

1.4 and 1.5 Revision of the previous grades work on number systems should be done because many candidates failed to respond to the binary manipulations in these questions. Only 46%

managed to perform binary division which is ironic because 69% could convert the decimal number to binary number in 1.4. This shows that the approach to binary divisions must be done by first changing the binary number to decimal and then perform decimal division operations.

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

- Teachers should use different methods when teaching the concept of quadratic equations and inequalities. It should be explained thoroughly to Candidates the difference between a linear equation and quadratic equation.
- Graphical approaches make it easier to explain the concept of whether the roots are real or non-real and where the solution lies in the case of inequalities. Revision of products and factors done in earlier grades should be done.
- Questions involving real-life technical applications should be given to Candidates during the teaching and learning process for Candidates to be able to link them with mathematics.
- Workshops before the topic is taught must be adopted by the districts so that Teachers can share their good expertise on the topic and Chief Markers Report and the Diagnostic Analysis must be mediated continuously in such workshops.

QUESTION 2

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

QUESTION 2

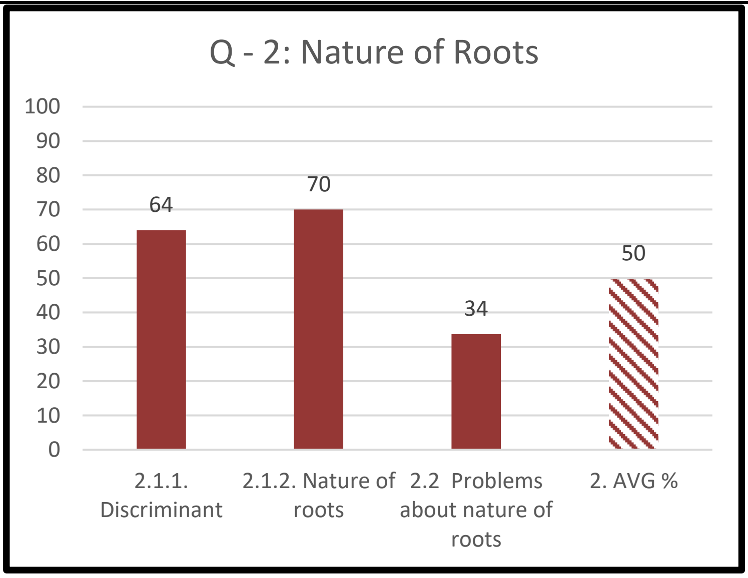
2.1 Given the equation: $x^2 - 4x + q = 0$

2.1.1 Determine the numerical value of the discriminant if $q = 4$ (2)

2.1.2 Hence, describe the nature of the roots of the equation. (1)

2.2 Determine the numerical value(s) of p for which the equation $x^2 - 4x + p = 0$ will have non-real roots. (3)

[6]



Q2 was well answered by candidates however Q 2.2 which covered proving problems about nature of roots, candidates did not do well, however, 2023 question 2 performance was better performed than all the other previous years performances. This shows that Teachers did implement some of the improvement strategies that were suggested in the previous years.

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

Q2 Candidates wrote the discriminant incorrectly as:

$$\Delta = 4ac - b^2 \; or \; \Delta = b - 4ac \; or \; \Delta = \frac{b^2-4c}{2a} \; or \; \Delta = -b^2 - 4a$$

Q2.1.1 Candidates failed to substitute the value of $q = 4$ in the place of c of the discriminant as a result they could not get the value of the discriminant.

Q2.1.2 Candidates failed to describe the nature of roots, some indicated that the roots are perfect squares, irrational and some writing rational together with non-real as one.

Q2.2 Candidates did not realize that for non-real roots $\Delta < 0$, they instead indicated $\Delta = 0$.

- Candidates like using quadratic formula when solving nature of roots problems instead of using the discriminant.

(c) Provide suggestions for improvement in relation to Teaching and Learning
Teachers should emphasise to Candidates that $\Delta = b^2 - 4ac$ is used to calculate the discriminant to describe the nature of roots. Candidates need to be taught that for non-real roots the discriminant is less than zero, $\Delta < 0$

(d) Describe any other specific observations relating to responses of Candidates and comments that are useful to teachers, subject advisors, teacher development etc.
• Integration of quadratic function with nature of roots is necessary for better understanding of the kind of roots a function or an equation has. • It should be stressed to Candidates that in the quadratic formula the term under the radical sign is the discriminant and used to determine the nature of the roots of the equation. • Use of visual representation will better illustrate this leading to a better understanding of the concept.

QUESTION 3

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

QUESTION 3

3.1 Simplify the following **without the use of a calculator**:

3.1.1 $\log_a a^{\frac{1}{2}}$ (1)

3.1.2 $\sqrt{5x}\left(\sqrt{45x} + 2\sqrt{80x}\right)$ (3)

3.1.3 $\left(\dfrac{4^{3n-2}}{2^{3n+2} \cdot 8^{n-3}}\right) \times 8$ (3)

3.2 Solve for x: $\log(2x-5) + \log 2 = 1$ (4)

3.3 Given the complex number: $z = 2 + 2i$

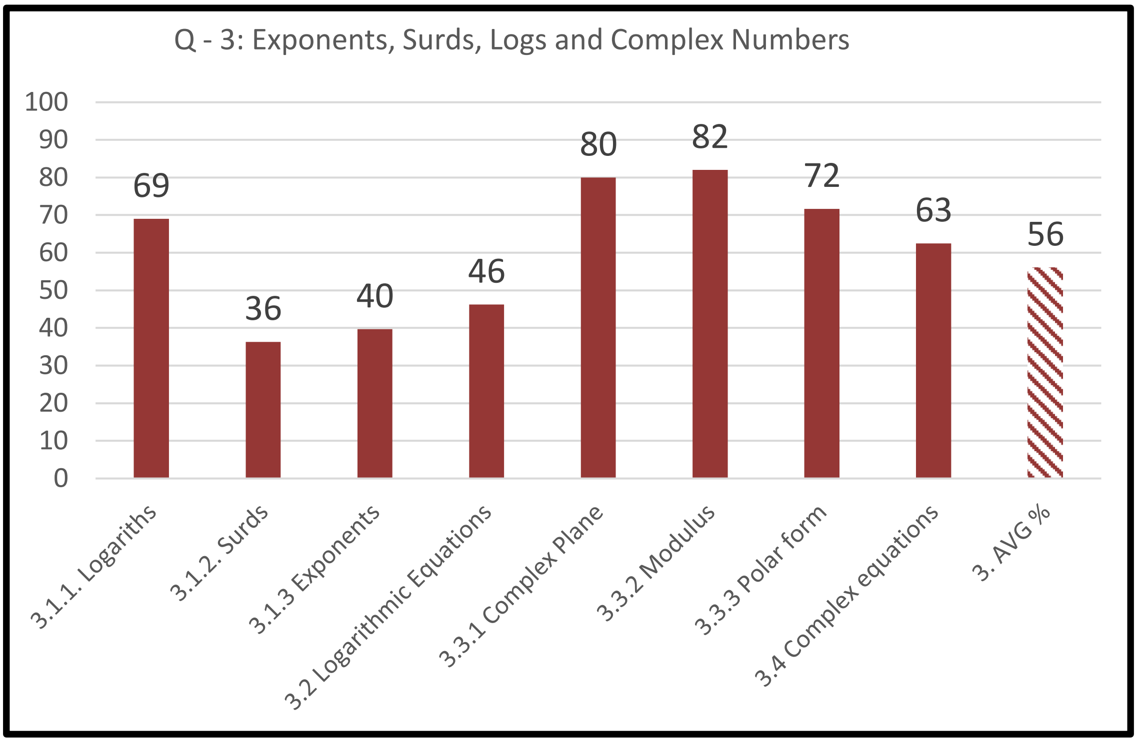
3.3.1 In which quadrant of the complex plane does z lie? (1)

3.3.2 Determine the value of the modulus of z. (2)

3.3.3 Hence, express z in polar form (give the angle in degrees). (3)

3.4 Solve for x and y if $x - 3yi = 6 + 9i$ (2)

[19]



Candidates performed well at an average of 56% in Q3. They did exceptionally well in Q3,.3.1, Q3.3.2 and Q3.3.3 which assessed Complex numbers. Questions where candidates performed well above 60% average assessed logarithms and complex equations. Surds in Q 3.1.2 was the least performed question at 36% average.

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

Q3.1 and Q3.2 Many candidates demonstrated limited knowledge and understanding of Exponential, Surds and logarithmic properties.

Q3.1.1 Few candidates changed the expression and wrote it as an equation: $\log_a a = \frac{1}{2}$

Q3.1.2 Candidates omitted brackets where indices have two terms: $8^{n-3} = 2^{3\times n\text{-}3}$

Q3.1.2 Candidates were unable to correctly change the surd form to exponential form, multiply surds and simplify the expression: $\sqrt{5x}\left(3\sqrt{5x} + 2.4\sqrt{5x}\right) = 15x^2 + 40x^2 = 55x^2$

Q3.3 There were few candidates who were unable to:

Q3.3.1 identify the correct quadrant in which the given complex number lies,

Q3.3.2 Correctly calculate the modulus using Pythagoras: $r = \sqrt{2^2 + 2i^2} = \sqrt{4 + (4-1)}$

Q3.3.3 find the angle using trigonometric ratio they selected random values. Q3.4 Candidates failed to apply distributive law, equating the real part to a real part and imaginary part to an imaginary part. Many candidates were unable to find the value of y because they could not correctly simplify the imaginary parts.

(c) Provide suggestions for improvement in relation to Teaching and Learning
• Exponential and Surd expressions or equations can easily be simplified if Teachers train their Learners on using a calculator to express any numerical term as a product of its prime factors (Prime factorisation). The departure will always be in that simplifications the algebraic manipulation follows. • Teachers need to ensure a thorough revision of the application of laws of exponents, surds, and logarithms is done and expose Candidates to different forms of representations. • Candidates should be exposed to different types of problems involving complex numbers and forms of expressing complex numbers in polar form or rectangular form.

(d) Describe any other specific observations relating to responses of Candidates and comments that are useful to teachers, subject advisors, teacher development etc.
• When teaching, an Argand diagram is useful in identifying the quadrant in which the real, imaginary part and angle are found. • Calculator use training is needed for the Learners to avoid the incorrect answers. • School managers must assist Technical Mathematics Teachers on making Learners buy their own calculators so that they are used to them. Borrowing a calculator on the day of examination makes Candidates get incorrect solutions.

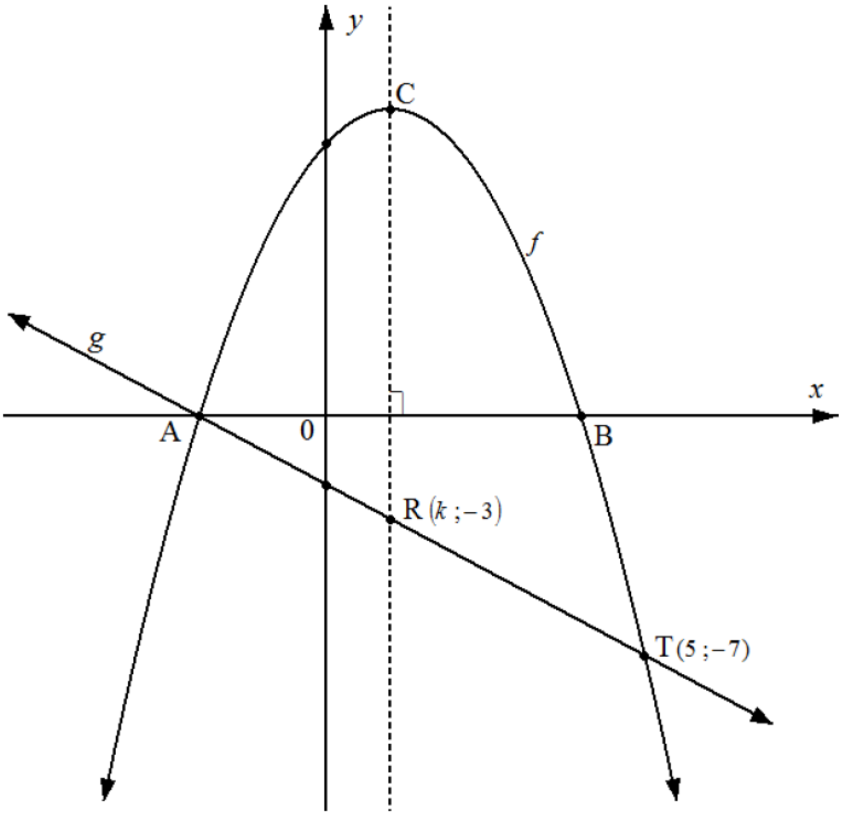
QUESTION 4
(a) General comment on the performance of Candidates in the specific question. Was the question well answered or poorly answered?

QUESTION 4

4.1 Sketched below are the graphs of functions f and g defined by:

$f(x) = ax^2 + bx + c$ and $g(x) = -x - 2$

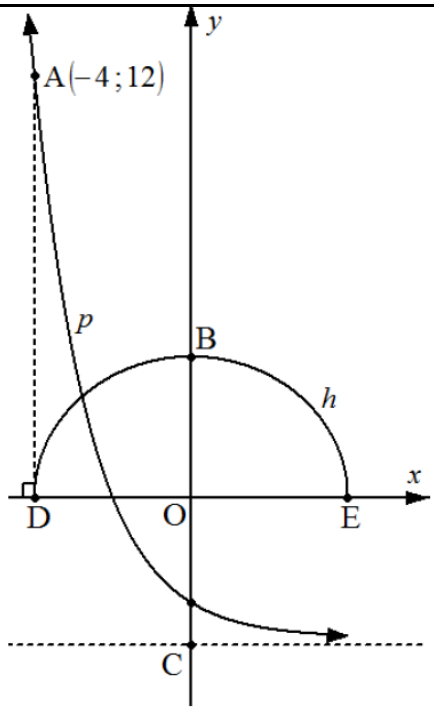
- A is the x-intercept of both f and g.
- B is the other x-intercept of f.
- A and $T(5\,;-7)$ are the points of intersection of f and g.
- C is the turning point of f.
- $R(k\,;-3)$ is a point on straight line g.
- CR is perpendicular to the x-axis.



4.1.1	Determine the x-coordinate of A.	(2)
4.1.2	Show that $k=1$	(1)
4.1.3	Hence, write down the x-coordinate of B.	(1)
4.1.4	Show that $f(x)=-x^2+2x+8$	(4)
4.1.5	Determine the range of f.	(3)
4.1.6	Write down the value(s) of x for which $f(x)\geq g(x)$	(2)

4.2 The graphs below represent functions p defined by $p(x)=a^x-4$ and semicircle h defined by $h(x)=\sqrt{r^2-x^2}$

- O is the origin.
- B is the y-intercept of h.
- Function p has a horizontal asymptote passing through C.
- D and E are the x-intercepts of h.
- $A(-4\,;12)$ is a point on p.
- AD is perpendicular to the x-axis.



4.2.1 Write down:

(a) The length of OD (1)

(b) The defining equation of function h (2)

4.2.2 Determine the numerical value of a. (3)

4.2.3 Determine the y-intercept of p. (2)

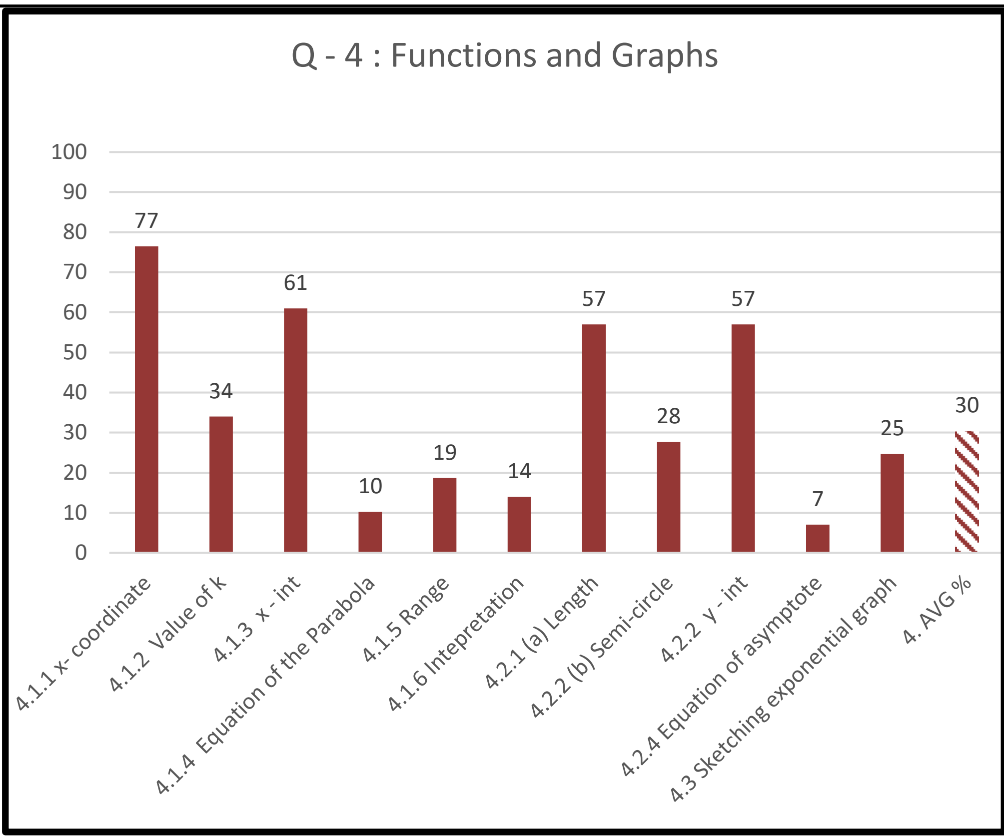
4.2.4 A new graph defined by $f(x) = p(x) + t$ is given.

Determine the equation of the asymptote of f if $(0\,;0)$ is the y-intercept of f. (2)

4.3 Given: $g(x) = \dfrac{k}{x} + q$ where $q > 0$ and $g(6) = 0$

Sketch the graph of function g on the ANSWER SHEET provided. Clearly show the intercepts with the axes and the asymptotes. (3)

[26]



Q4 was not well performed by the candidates. The average for this question was 30%. Six sub-questions' performance was below 30% and these questions were mainly assessing the interpretation of graphs. Candidates did well in questions where coordinates and lengths were required.

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

- Some scripts had all the information needed for one to draw a graph on 4.3 and 7.5 but there were no graphs papers, an indicator that the graph paper was never included in the answer script.

Q4.1.1 and Q4.1.3 Candidates confused the x and y-intercepts when representing them as a set of ordered pairs. They wrote them interchangeably.

Q4.1.2 Many candidates were unable to show that $k = 1$. They found $g(-3) = -(-3) - 2 = 1$ and concluded that $k = 1$

Q4.1.4 Many candidates did not realise that showing $f(x) = -x^2 + 2x + 8$ meant finding the equation of the parabola, they instead solved for x values which were already asked in previous questions.

Q4.1.5 Candidates failed to write the correct notation for the range, many left it at $y = 9$

Q4.1.6 Candidates failed to correctly interpret the question and identify the end points where $f \geq g$

Incorrect notation used by candidates: $(-2; 5)$ as well as $-2 > x \text{ or } x < 5$

Q4.2.1 Many candidates gave the length of OD as -4

Q4.2.2 Candidates wrote equation of the semi-circle in standard form, $h(x) = \sqrt{r^2 - x^2}$, did not substitute the value of r.

Q4.2.4 Majority of candidates did not realise that (0;0) is found by shifting the graph 3 units up.

Q4.3 Many candidates failed to draw the function using the given information. They lacked the knowledge of the characteristics and properties of the exponential function.

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

- Various approaches to the teaching of Functions must be done. Sketching and responding to questions from graphs that have already been drawn (Interpretation)
- Teachers should expose Candidates to different functions and their unique characteristics. The effect of parameters (a, p and q) can be taught using various software this also covers the transformation of graphs.

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

- Candidates should be exposed to different questioning strategies. Teaching of graphs should not be limited to just diagrams incorporate interpretation as well.
- Technical Mathematics Teachers must train their Learners to always start by stapling the graph sheets to the back of the question papers so that they may not be lost.

QUESTION 5

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

QUESTION 5

5.1 The nominal interest rate charged is 8% per annum, compounded monthly.

Calculate the annual effective interest rate charged. (3)

5.2 R25 000 is invested at an interest rate of $9{,}6\%$ per annum, compounded quarterly.

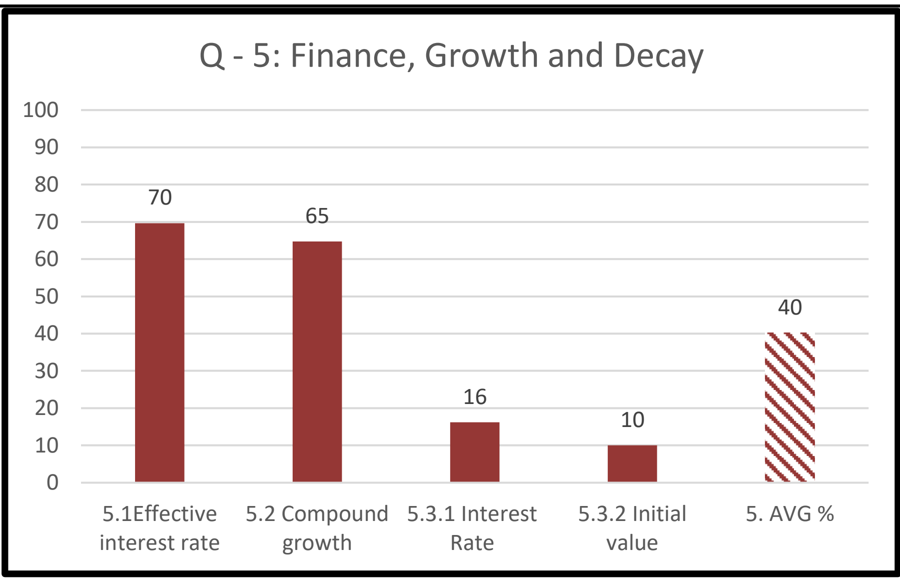
Determine the value of the investment at the end of 7 years. (4)

5.3 The temperature of a very hot metal rod is taken using a thermometer that can only take readings up to 200 °C. The temperature of the given metal rod is greater than 200 °C at room temperature. Under controlled conditions, the temperature of the metal rod decreases at a rate of $r\%$ per minute using the reducing balance method.

- After six minutes the metal rod has cooled sufficiently and its temperature measures 80 °C.
- Two minutes later the temperature drops to 50 °C.

5.3.1 Show that $r \approx 21$ (4)

5.3.2 Hence, calculate the initial temperature of the metal rod. (3)
[14]



The question was fairly performed at an average of 40%. In Q5.1 and Q5.2 candidates did very well, the question assessed Effective interest rate and compound growth. Question that was poorly performed at an average below 20% was Q5.3, required candidates to make r and P the subject of the formula.

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

Q5.1 Some candidates failed to identify the correct formula. Many candidates had difficulty in making i the subject of the formula. There were candidates who did not write the rate in percentage.

Q5.2 Few candidates used simple interest formula instead of compound growth.

Q5.3 Candidates failed to interpret the statement and used incorrect formula. They swapped the values of P and A resulting in incorrect substitution. Candidates had difficulty in making r and P the subject of the formula.

Candidates failed to identify the compounding term resulting in incorrect values of n.

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

- Grade 10 Literal equations must be revised with the Learners to avoid the challenges of making any variable or parameter the subject of the formula.
- Candidates should be encouraged to read and interpret what they have read even during teaching and learning in class.
- As part of SBA, a project involving Finance, Growth and Decay should be given to Candidates to cover the aspect of real- life applications as one of the specific aims of Technical Mathematics. This can help make Learners see the essential importance of Finance, growth and decay in their lives.

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

Mathematics has its own language which Candidates should be exposed to as well as to the day-to-day language used at school, home and communities where they reside. They should be able to link what they know at home with what they learn in class for better understanding of Financial Mathematics concept including population.

QUESTION 6

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

QUESTION 6

6.1 Given: $f(x) = x - 5$

Determine $f^{/}(x)$ using FIRST PRINCIPLES. (5)

6.2 Determine:

6.2.1 $D_x\left[-3x^9 - 7x\right]$ (2)

6.2.2 $f^{/}(x)$ if $f(x) = \dfrac{3}{2x} + \sqrt[5]{x^{-2}}$ (4)

6.2.3 $\dfrac{dy}{dt}$ if $y^3 t^2 = 64t^{11}$ (3)

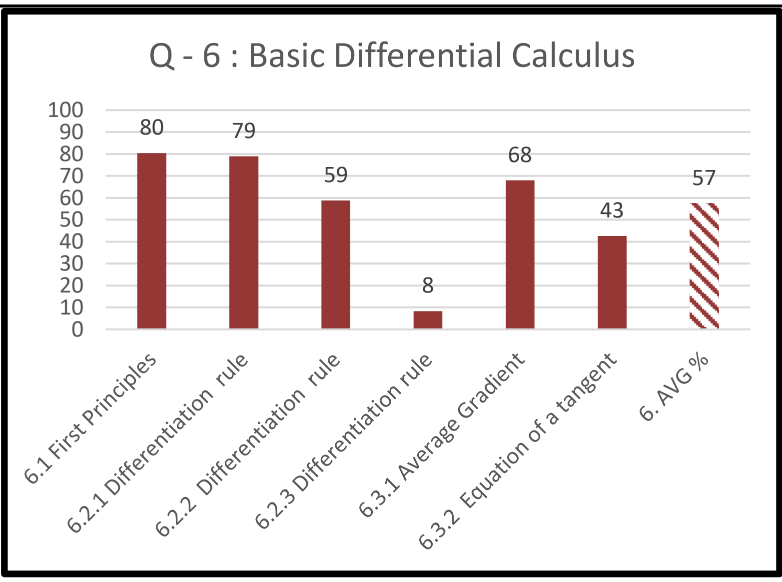
6.3 Given: $h(x) = -2x^2 + x - 5$

6.3.1 Calculate $h(1)$. (1)

6.3.2 Hence, determine the average gradient of h between the points $(1\,;\,h(1))$ and $(-3\,;\,-26)$. (3)

6.4 Determine the equation of the tangent to the curve defined by $f(x) = x^3 + 2$ at $x = 4$ (5)

[23]



Generally, this question was well performed by candidates at an average of 57%. The best performed question at 80% average was Q 6.1 which assessed First principles and the poorly performed question, at 8% average was Q6.2.3 where candidates were supposed to manipulate the equation and make y the subject thus finding the derivative function of y.

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

Q6.1 Few candidates did not write the correct definition and lost mark for incorrect notation. They omitted brackets when doing the substitution and incorrectly simplified the expression.

- $f(x) = \lim_{h \to 0} \frac{f(x+h)-f(x)}{h}$ OR $f'(x) = \frac{f(x+h)-f(x)}{h}$
- $f'(x) = \lim_{h \to 0} \frac{x+h-5-x-5}{h}$
- $f'(x) = \lim_{h \to 0} \frac{h}{h} = 0$
- Some candidates had notational errors of continuing to write limits though the final answer had been reached.

Q6.2 Candidates did not simplify further: $-27x^{8-1} - 7x^{1-1} \quad or \quad -3 \times 9x^{8-1} - 1 \times 7^{1-1}$

Some candidates mixed differentiation and integration: $\frac{-27 \times 8^{8+1}}{8+1} - \frac{7 \times -1x^{-1+1}}{-1+1}$

Candidates failed to correctly remove the radical sign and invert x in the denominator for the first term rather they changed the fraction altogether: $3 \times 2x^{-1} + x^{-\frac{5}{2}}$ (SRFD)

Candidates demonstrated a limited understanding of exponential laws needed to manipulate the equation and make y the subject thus finding the derivative function of y.

Q6.3.2 Candidates failed to identify the correct formula to calculate the gradient, they instead use the midpoint formula, incorrect use of brackets

6.4 Most candidates failed to relate gradient to derivative of the function hence they used the gradient formula instead of the derivative. Few candidates used the average gradient asked in 6.3.2.

Candidates swapped the y- value and gradient value when substituting in the equation of the straight line: $g'(4) = 48 \; and \; g(4) = 66$ and they wrote $y - 48 = 66(x - 4)$ as a result they lost a mark.

There were few candidates who used the formula for angle of inclination $m = tan$

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

- Expose Candidates to the information sheet; the definition can be copied from it. Teachers should emphasize correct use of notation.
- Provide Candidates with drill and practise exercises determining the derivative from first principles and applying the rules of differentiation.
- The original function must be in the differentiable form before the rules of differentiation can be applied.

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

- Candidates should be provided with an information sheet when writing assessment to familiarize them with it instead of only getting it in the final NSC papers.
- Activities given for revision should not be limited to those where the variable to differentiated with respect to, is the subject, they should be given equations or expressions where they have to manipulate first and variables used should not be limited to x and y.

QUESTION 7

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

QUESTION 7

Given function g defined by $g(x) = -x^3 + 5x^2 + 8x - 12$

7.1 Write down the y-intercept of g. (1)

7.2 Determine $g(-2)$. (1)

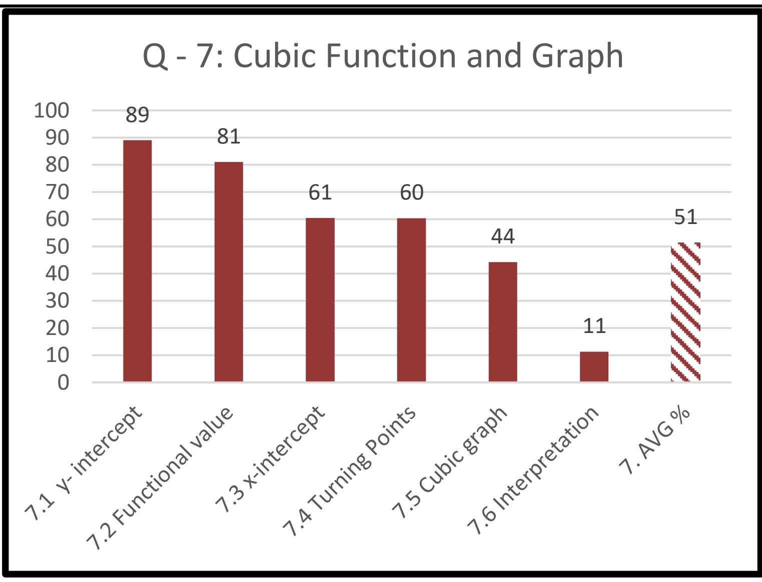
7.3 Hence, determine the x-intercepts of g. (4)

7.4 Determine the coordinates of the turning points of g. (5)

7.5 Sketch the graph of g on the ANSWER SHEET provided. Clearly show ALL intercepts with the axes as well as the turning points. (4)

7.6 Use your graph to write down the values of x for which $g(x) < 0$ (3)

[18]



Q7 was well answered by candidates at an average of 51 %. The candidates did exceptionally well in Q7.1 and Q7.2 assessing y -intercept and function values but poor in Q7.6 requiring interpretation of graphs. Candidates performed well at an average of 60% and above for Q7.3 and Q7.4, these questions required x – intercepts and coordinates of turning points.

Q7.5 where candidates were required to draw the cubic graph was fairly performed at 44%.

(b) Why were the questions poorly answered? Also provide specific examples, indicate common errors committed by Candidates in this question, and any misconceptions.
Q7.1 Few candidates failed to identify and write the $y = -12$ from the given equation. Q7.2 Few candidates failed to simply the equation after substitution. Q7.3 Candidates failed to use information from Q7.2 instead they started from the beginning by finding the roots of a cubic equation by using a quadratic formula. Many candidates confused the $x -$ intercepts with coordinates of turning points. Q7.4 Candidates failed to follow the instruction on correct numbering. They either wrote response for Q7.4 in Q7.3 or omit Q7.3 or Q 7.4. Many candidates did not completely answer this question because part one of it was done in Q 7.3, they just wrote the coordinates of the turning points. Q7.5 Candidates failed to draw the correct graph because of incorrect calculations of intercepts and turning points, this affected mainly the shape of the graph. Few candidates did not put in their answer sheet and did not draw the graph in the answer sheet. Q7.6 Most candidates failed to interpret this question and did not write it, those who were able to identify critical values failed to write the correct interval notation.

(c) Provide suggestions for improvement in relation to Teaching and Learning
Following instructions and correct numbering should be emphasized to Candidates. • Teachers should expose Candidates to different functions and their unique characteristics. • Teachers should explain the concept of minima and maxima and demonstrate to Candidates where the graph is increasing and decreasing and stationary by means of diagrams. This should include the concept of the derivative of the function and the turning point.

(d) Describe any other specific observations relating to responses of Candidates and comments that are useful to teachers, subject advisors, teacher development etc.
Use of a variety of available software by teachers will enable Candidates to clearly see where the graph is decreasing and increasing will greatly assist in the interpretation of functions.

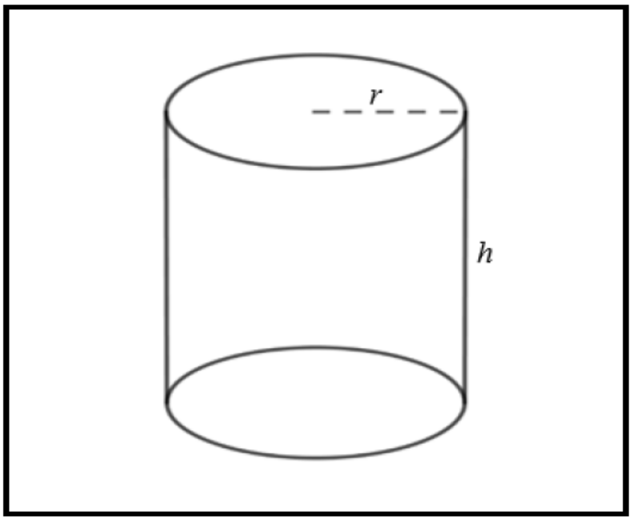
QUESTION 8
(a) General comment on the performance of Candidates in the specific question. Was the question well answered or poorly answered?

QUESTION 8

A company has been contracted to manufacture right cylindrical cans to package baked beans.

The volume of a can is 350 mℓ.

The diagram below shows a can with a radius of r cm and a height of h cm.



The following formulae may be used:

Volume = (area of the base) × height = $\pi r^2 h$

Total surface area = 2× (area of the base) + (perimeter of the base) × height
$= 2\pi r^2 + 2\pi r h$

NOTE: 1 mℓ = 1 cm^3

8.1 Show that the height can be expressed as $h = \dfrac{350}{\pi r^2}$ (1)

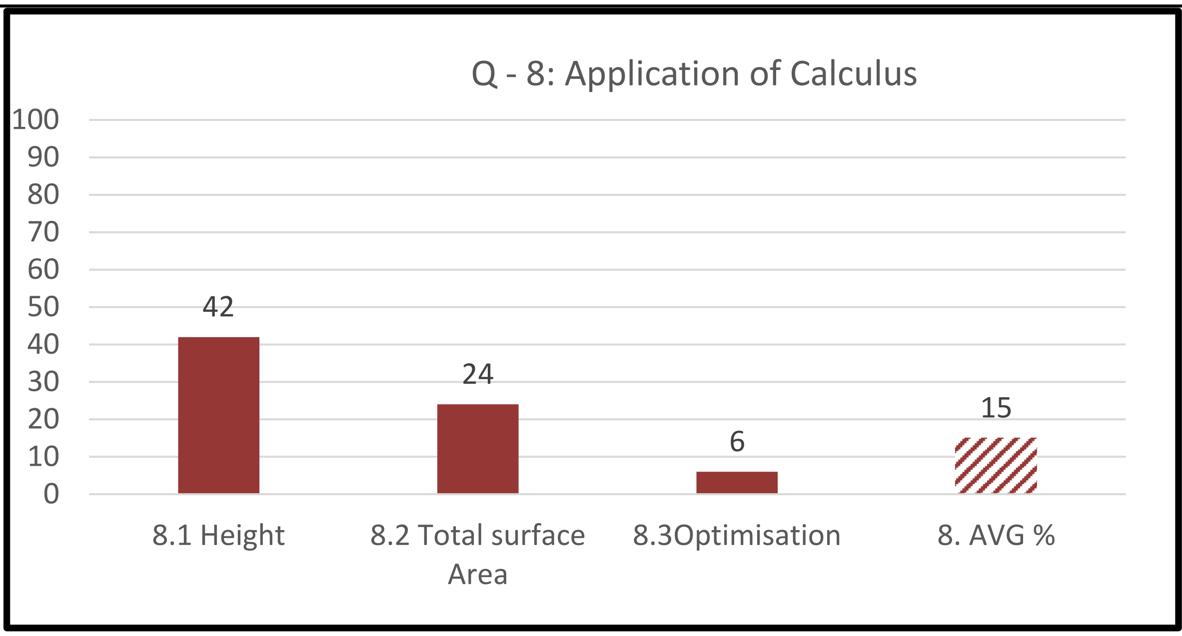
8.2 Hence, show that the total surface area (A) can be expressed as:

$$A(r) = 2\pi r^2 + \frac{700}{r}$$

(2)

8.3 Hence, determine the dimensions of the can if the total surface area is to be a minimum. (5)

[8]



This question was poorly performed at an average of 15%. Performance in Q 8.2 and Q 8.3 both were below the average of 30%.the questions assessed Total Surface Area and Optimisation.

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

Q8.1 Many candidates did not realize that they were supposed to use the formula for volume to get the height.

Q8.2 and Q8.3 Many candidates did not attempt these questions, those who attempted them struggled to correctly differentiate the equation to find r and h.

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

Candidates should be made aware that they need to identify and write correct formula and that HENCE means the use of the answer obtained to solve the current question.

Mensuration should be given attention and more activities be given to Candidates.

The concept of Minimum and maximum should be thoroughly explained to Candidates. The procedure should be clearly illustrated. Different questioning strategies should be employed by teachers in class activities, tests and examinations

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

- Expose Candidates to questions involving modelling and technical applications.
- Drill Candidates on the questions where after failing to answer a 'show' type question, it does not mean the end of the world to them, but they should use that formula to answer the following questions.
- Different formulae involving solids, cones and pyramids etc. should be taught to Candidates and how they can be used as part of the real-life context.

QUESTION 9

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

QUESTION 9

9.1 Determine the following integrals:

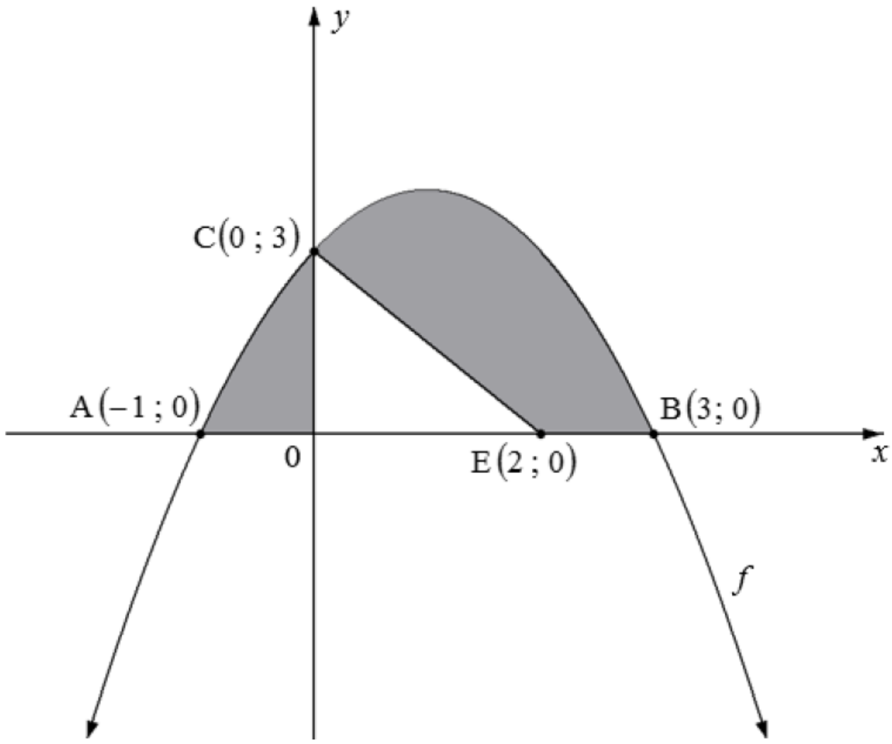
9.1.1 $\int -4 \; dt$ (2)

9.1.2 $\int x^5 \left(x^3 - 9x^{-6}\right) dx$ (3)

9.2 The diagram below shows function f defined by $f(x) = -x^2 + 2x + 3$

The graph of f cuts the x-axis at $A(-1;0)$ and $B(3;0)$ and the y-axis at point $C(0;3)$.

$E(2;0)$ is a point on the x-axis.

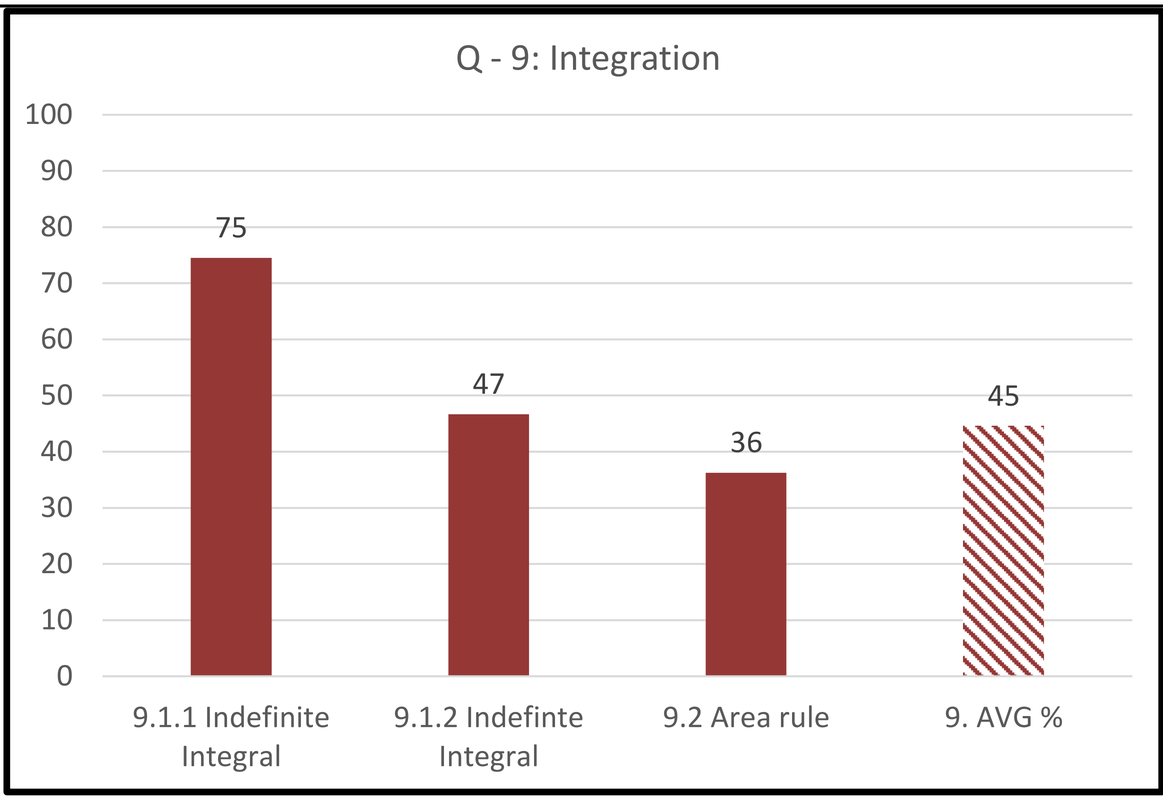


Determine the total shaded area represented in the diagram above.

Clearly show ALL working. (8)

[13]

TOTAL: 150



This question was performed well at 45% average. The best performed sub- question was Q9.1.1 which assessed indefinite integral at 75% average. The area rule assessed in Q 9.2 candidates performed fairly just above the average of 35%.

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

Q9.1 Few candidates failed to write the integral in terms of *t:* $\int -4\, dt = -4x + c$.

Some candidates omitted the c when writing the integral.

Q9.1.2 Many candidates failed to simplify the expression first, they wrote $\frac{x^6}{6}\left(\frac{x^4}{4} - \frac{9x^{-5}}{-5}\right) + c$ and lost the marks. They also did not apply the integration rules incorrectly: $\int x^8 - 9x^{-1}\, dx = \frac{x^9}{9} - \frac{9x^{-1+1}}{-1+1}$ they did not recall that $\int \frac{1}{x} dx = lnx + c$. (SRFI)

Q9.2 Majority of candidates were unable to set up the area using integration, they did not know the exact boundaries to use leading to mismatch of boundaries. Many candidates confused integration with differentiation. Some candidates incorrectly substituted lower and upper limits. There were a few candidates who left the Area as a negative value.

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

- Candidates should be taught the rules that apply in Integration.
- They should be reminded that the constant C for indefinite integrals should not be omitted. Upper and lower limits must always be included in the notation for definite integrals.
- Teachers should to Candidates emphasise that the area cannot be negative.
- Revision of algebra done in earlier grades should be done o assist learner to better understand the concept of simplification first.

(d) Describe any other specific observations relating to responses of Candidates and comments that are useful to teachers, subject advisors, teacher development etc.
Teachers should expose Candidates to expressions with different variables other than x. There should be a clear demonstration on how the integration and differentiation differ with one another. Emphasise to Candidates to take note of the different notations used: $\int f(x)\, dx$ for integral and $\frac{dy}{dx}$ or D_x or $f^{/}$ for derivative.