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15 December 2020

Dr HW Mweli
Director General
Department of Basic Education
222 Struben Street
Pretoria

Dear Dr Mweli

AMESA report on 2020 Grade 12 Mathematics, Technical Mathematics & Mathematical Literacy Papers

Since 2009, AMESA has been involved in workshop activities which focused on the grade 12 Mathematics & Mathematical Literacy examination papers. These workshop activities take place in the various AMESA regions (provinces). The AMESA National Curriculum Committee then consolidates the input from the regions.

2020 marks the 12th year in which AMESA has been involved in these workshop activities. While 2020 has been a difficult year for the world in so many spheres, including education, we are thankful that we were able to salvage the grade 12 Academic year in South Africa. Further, there has been keen teacher participation in the grade 12 reviews and the feedback from the AMESA regions, regarding these workshop activities (both face-to-face and virtual) has been very positive.

It is my honour and privilege to send our 2020 report to you. The delay in sending this report to you was caused by the uncertainty regarding Mathematics Paper 2 and its possible rewrite. While we appreciate the reasons for having a rewrite, we are certain that the court action in nullifying the rewrite has been done in the best interests of the learners (who have had a very difficult year) and trust that the DBE and UMALUSI will come to an agreement that is amicable to all concerned.

The purpose of the report is to provide constructive feedback, on the grade 12 papers, to the Department of Basic Education. We do this in the spirit of promoting mathematics education and enhancing the quality of the teaching and learning of Mathematics related subjects in South Africa. It is our hope that the report and the question by question analyses will be useful to the examiners, moderators and markers in our attempt to promote a high standard of mathematics education in our country.

Yours in quality Mathematics Education

Professor Rajendran Govender

AMESA President

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AMESA Review of Grade 12 Examination Papers: Mathematics; Technical Mathematics and Mathematical Literacy

December 2020

Report compiled by Dr VG Govender (AMESA National Executive Member and Head of AMESA Curriculum committee)

1. CONTENTS

2. INTRODUCTION

Since 2009, AMESA has been involved in workshop activities which focused on the grade 12 Mathematics & Mathematical Literacy examination papers. These workshop activities take place in the various AMESA regions (provinces). The AMESA National Curriculum Committee then consolidates the input from the regions.

2020 marks the twelfth year in which AMESA has been involved in these workshop activities. Despite the COVID-19 pandemic, there has been keen teacher participation in these activities (both face-to-face and virtual and the feedback from the AMESA regions, has generally been positive. We appreciate the fact that there has been stability in the standard of the papers.

AMESA is aware of the many challenges facing Mathematics teaching and learning in South Africa and much of these challenges stem from the earlier grades. We believe that more should be done for teacher development in these grades and AMESA is ideally placed to assist the Department of Basic Education (DBE) in addressing some of these challenges. We also note that 2020 has been a very disruptive and difficult year for education and we appreciate the efforts by the DBE to salvage the 2020 school year for grade 12 learners. However, we are concerned about the reports of the leakage of Mathematics Paper 2. We know that the DBE is investigating this very serious breach of national security and trust that the culprits will be brought to book. We also appreciate the call by the DBE for learners not to panic and that learners will not be severely disadvantaged by these leaks.

Mathematics, Technical Mathematics and Mathematical Literacy were written nationally on Thursday 12 November 2020 (paper 1) and Monday 16 November 2020 (paper 2). After these papers were written, teachers, under the banner of AMESA, participated in workshops in various AMESA regions. The focus of these workshops was the analyses of these examination papers.

The following key issues were discussed at these workshops and are shown in this report:

Technical aspects; Language used; Syllabus coverage; Standard of the paper; Compliance with levels of thinking (cognitive levels); Comparison to the 2019 paper; Learners views on the papers, Unfair questions and Overall verdict.

At the end of each paper review is a **question-by-question analysis** and a **summary of the cognitive levels** for each question (actual marks and percentages).

The purpose of this report is to provide constructive feedback, on the grade 12 papers, to the Department of Basic Education. We do this in the spirit of promoting mathematics education and enhancing the quality of the teaching and learning of Mathematics in South Africa. It is our hope that the report and the question by question analyses will be useful to the examiners, moderators and markers in our attempt to promote a high standard of mathematics education in our country.

We firmly believe that the DBE, School teachers, Subject Advisors, University Academics; Subject Advisors and others will find the contents of this report thought-provoking and useful.

AMESA National Executive

3. MATHEMATICS PAPER 1

A. Overall Review

1. Technical Aspects (typing; diagrams; etc)

The DBE is to be complimented for producing papers which are technically of a very high standard. Mathematics Paper 1 was neatly typed and all the information was presented in a clear, unambiguous manner. The use of bullets in some of the questions made reading easier. Although the sketch in 4.2 was not consistent with other sketches in the paper, as far as line thickness is concerned, all information was accessible to the candidates.

2. Language used

The language in the paper would be within the grasp of most grade 12 mathematics learners. The language usage was good, unambiguous and unbiased throughout the question paper. The use of bullets in certain questions appeared to help learners with making sense of the questions.

Only question 11 posed a bit of a language problem, especially 11.1 and 11.3

3. Syllabus coverage

Code	Content/Topic	Suggested	Actual
1	Algebra and equations (inequalities)	25 ($\pm$ 3)	22
2	Patterns and sequences	25 ($\pm$ 3)	25
3	Finance, growth and decay	15 ($\pm$ 3)	16
4	Functions and graphs	35 ($\pm$ 3)	35
5	Differential calculus	35 ($\pm$ 3)	37
6	Probability	15 ($\pm$ 3)	15
	TOTAL	150	150

Mathematics Paper examines 6 of the 10 content areas. In terms of content coverage, all these content areas/topics were covered within the prescripts of the CAPS document.

4.1 Standard of paper

Candidates had a good “welcome to the paper” in question 1 which probably gave them confidence for the rest of the paper. Questions 1; 4.1, 7 and part of question 2

presented learners with a sizeable proportion of level 1 and level 2 questions, which were mostly accessible.

The questions were “well structured” with “easy” questions to start off with and then a gradual increase in the level of difficulty per question. However, questions 1.3 (3), 2.2.4 (4), 3.2 (5), 4.2.6 (4), 5.4 (3), 5.5 (3), 6.3.2 (4), 8.4 (4), 8.5 (5), Q9 (10) and 11.3 (3) required candidates to have mathematical insight, analytical thinking and conceptual understanding.

4.2 Compliance with levels of thinking:

‘Levels of thinking	Suggested	November 2020
1 – Knowledge	± 20%	15,3%
2 - Routine procedures	± 35%	40,7%
3 - Complex procedures	± 30%	28,0%
4 - Solving problems	± 15%	16,0%

Mathematics Paper 1 appears to be cognitively balanced with 56% of the paper, according to our analyses, comprising level 1 (knowledge) and level 2 (routine procedures) questions and 44% comprising level 3 (complex procedures) and level 4 (problem solving) questions. This is in line with the CAPS document.

5. Comparison with 2019 paper

An extra column is added to the table in 4.2 to show our allocation of levels of thinking for the 2019 paper.

Levels of thinking	Suggested	November 2020	November 2019
1 – Knowledge	± 20%	15,3%	15%
2 - Routine procedures	± 35%	40,7%	33%
3 - Complex procedures	± 30%	28,0%	33%
4 - Solving problems	± 15%	16,0%	19%

We note that the 2020 Mathematics Paper 1 was definitely less challenging than the 2019 paper. In 2019 the paper was loaded with many hurdles along the way, almost

in every question. Candidates never got a chance to feel comfortable. In some cases, the challenging questions were right at the start of a particular question.

The 2020 Mathematics Paper 1 was definitely more candidate friendly with the questions well- structured from easy to medium to difficult/challenging.

6. Unfair question(s): State question(s) and indicate why the question(s) are regarded as unfair:

There were **no unfair** questions identified in the paper that would disadvantage any candidate in any way. However, there were a number of unseen, challenging questions throughout the paper (usually the last one in the question.

7. Learners views of the paper

Learners, surveyed, felt it was better and more accessible than the recent Trial paper They indicated that the paper was fair and the time allocation was good. .
Although many learners felt that there were no unfair questions, many mentioned questions 5, 9, 10 and 11 as quite challenging (not unfair). They also identified some other sub-questions as challenging, eg. 1.3, 3.2 , 4.2.4 and 8.5.

8. Overall verdict

The paper was of a good standard catering for all different levels of candidates. Although the questions were much more accessible to candidates, it had its fair share of challenging questions for, especially, the top candidates.

We are able to classify the paper as follows:

"A well-balanced, fair paper allowing candidates to showcase their mathematical knowledge and abilities"

B. Question by question analysis

Question 1: Algebra and equations								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
1.1.1	Quadratic equation	2				2	1	Factorise
1.1.2	Quadratic equation (formula)	3				3		Use formula
1.1.3	Quadratic inequality			3		3		Swopping first bracket makes question harder
1.1.4	Surd equation		5			5		Square both sides and solve
1.2	Simultaneous equations		6			6		Routine question
1.3	Exponential inequality				3	3		Take 100th root on both sides
	TOTAL	**5**	**11**	**3**	**3**	**22**		

Question 2: Patterns and sequences								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
2.1	Arithmetic sequence		4			4	2	Finding unknowns in AS
2.2.1	General term of quad sequence		4			4		General term for Qdr Pattern
2.2.2	50th term of quad sequence		2			2		Finding Specific term value
2.2.3	Sum of n first differences			3		3		Sum of Arithmetic Sequence
2.2.4	Consecutive first differences			4		4		Solving for n using given info
	TOTAL		**10**	**7**		**17**		

Question 3: Patterns and sequences								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
3.1	Geometric series in sigma notation		3			3	2	G.S – Test for convergence
3.2	Given the sum of geometric series; find p			5		5		Sum to infinity – Sigma Not.
	TOTAL		**3**	**5**		**8**		

Question 4: Functions and Graphs								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
4.1.1	Asymptotes	2				2	4	Equations of Asymptotes
4.1.2	Axis of symmetry		2			2		Equations of Axis of symmetry
4.1.3	Sketch of hyperbola		4			4		Sketch Hyperbola
4.2.1	Coordinates of minimum value	2				2		Turning point of Parabola
4.2.2	Range of parabola	1				1		Range of Parabola
4.2.3	Point of intersection between axis of symmetry and straight line		3			3		Coordinates of point on line
4.2.4	Area of trapezium			3		3		Area of Trapezium
4.2.5	Inverse of g		2			2		Equation of Inverse of straight line
4.2.6	Point of contact between h and f				4	4		Coordinates of contact point
	TOTAL	**5**	**11**	**3**	**4**	**23**		

Question 5: Functions and Graphs								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
5.1	Intersection of exp graph and y axis	1				1	4	Coordinates of y-intercept
5.2	Intersection of exp graph and y = 9		3			3		Point of intersection
5.3	Domain of f inverse	2				2		Domain of inverse function
5.4	Translation			3		3		Graph Transformation
5.5	Exponential inequality (use graph)				3	3		Solving graph inequality
	TOTAL	**3**	**3**	**3**	**3**	**12**		

Question 6: Finance, growth and decay								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
6.1.1	Investment after last deposit		4			4	3	Future value of investment
6.1.2	Future value	2				2		Growth of an investment
6.2	Depreciation		3			3		Finding n - Depreciated value
6.3.1	Value of loan		3			3		Calculating value of loan
6.3.2	Interest payable			4		4		Interest paid after a period
	TOTAL	**2**	**10**	**4**		**16**		

Question 7: Calculus (First principles and rules for differentiation)								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
7.1	First principles	2	3			5	5	Use first principles steps
7.2.1	Rules for differentiation		3			3		Differential Rules
7.2.2	Rules for differentiation			4		4		Factorisation & Differentiation Rules
	TOTAL	**2**	**6**	**4**		**12**		

Question 8: Calculus (Cubic graph)								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
8.1	Increasing function	2				2	5	Increasing interval
8.2	Point of inflection	2				2		Point of inflection
8.3	Concave down		2			2		Concavity
8.4	Given derivative find the function			4		4		Finding g(x) from g'(x)
8.5	Equation of tangent				5	5		Tangent with max gradient
	TOTAL	**4**	**2**	**4**	**5**	**15**		

Question 9: Calculus (Optimisation)								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
9.1	Cost to construct box			4		4	5	Setting up the function
9.2	Width of box				6	6		Maxima and Minima
	TOTAL			**4**	**6**	**10**		

Question 10: Probability and counting principles								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
10.1	10 digit telephone numbers	2				2	6	Counting Principle-repetition
10.2.1	Valid numbers (with restrictions)		1	2		3		Counting – with restrictions
10.2.2	Probability (valid phone number)		2			2		Probability of event
	TOTAL	**2**	**3**	**2**		**7**		

Question 11: Probability (tree diagram application)								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
11.1	Probability		2			2	6	Probability of event twice
11.2	Probability			3		3		Probability of event thrice
11.3	Probability				3	3		Probability to Infinity
								Probability of event twice
	TOTAL		**2**	**3**	**3**	**8**		

Summary of levels per question

Levels/ Questions	1	2	3	4	Total
1	5	11	3	3	**22**
2	-	10	7	-	**17**
3	-	3	5	-	**8**
4	5	11	3	4	**23**
5	3	3	3	3	**12**
6	2	10	4	-	**16**
7	2	6	4		**12**
8	4	2	4	5	**15**
9			4	6	**10**
10	2	3	2		**7**
11	-	2	3	3	**8**
Total	**23**	**61**	**42**	**24**	**150**

Overall total	**Levels**				**Marks**
	1	**2**	**3**	**4**	
All questions	23	61	42	24	150
Percentage	15,3%	40,7%	28,0%	16,0%	100%

4. MATHEMATICS PAPER 2

A. Overall Review

1. Technical Aspects (typing; diagrams; etc)

Mathematics Paper 2 was neatly typed, with all information clearly legible. However, there were some technical inconsistencies which, although not impacting on the essence of the paper, need to be corrected for future papers:

For example, the diagram in question 3 had the x of the x-axis above the x-axis; in question 4 it was below the x-axis; in question 5 it was on the side.

There were also issues in the diagrams in 8.1 (L and N on the circumference); 9.2 (M on the circumference) and the depiction of the parallel lines in the diagram for question 3 in the answer book.

2. Language used

The language used in the paper would be accessible to most grade 12 learners. However, question 2 appeared to be very verbose, with lots of writing. Thus, a fair bit of comprehension and understanding would be required for this question. This could have been avoided with the use of shorter sentences; this would have made it easier for learners to understand and grasp the questions. The use of bullets (as used in Mathematics Paper 1) would have definitely helped.

In question 4.5, the wording in the English version of the paper, “centred at M” may lead to the assumption that the circles “touch” at M; candidates may also be confused as to whether a large circle may touch and intersect another circle.

3. Syllabus coverage:

Code	Content/Topic	Suggested	Actual
1	Statistics	20 ($\pm$ 3)	19
2	Analytical Geometry	40 ($\pm$ 3)	40
3	Trigonometry	40 ($\pm$ 3)	42
4	Euclidean Geometry and measurement	50 ($\pm$ 3)	49
	TOTAL	150	150

Mathematics Paper 2 assesses 4 of the 10 content areas/topics in the subject. A quick glance at the above table shows that coverage of these content areas/topics were clearly in line with prescripts of the CAPS document.

4.1 Standard of paper

There was a good start to the paper Statistics assessed in the first two questions. Most candidates should do well in these two questions. However, candidates with a "language problem" may have found question 2 to be verbose and time consuming.

Although the questions in the paper should have been accessible to most learners, the use of fractional and decimal calculations, especially in Analytical Geometry, may cause some learners to "second guess" some answers and, thus, waste, time. The content examined were fine but the overuse of fractions may result in a "breakdown" in candidates' responses.

The Trigonometry part of the part required deep, analytical thinking in a number of its questions. The Euclidean Geometry was extremely fair. However, the fact that Euclidean Geometry questions were the last 3 in the paper, those learners who managed to get to these questions, assuming they followed the order in the paper, may not have been in a "good head space" to answer these questions.

4.2 Compliance with levels of thinking

Levels of thinking	Suggested	November 2020
1- Knowledge	± 20%	17,3%
2- Routine procedures	± 35%	37,4%
3- Complex procedures	± 30%	28,0%
4- Solving problems	± 15%	17,3%

54,7% of Mathematics Paper comprised level 1 (Knowledge) and level 2 (Routine procedures) questions with 45,3% comprising level 3 (Complex procedures) and level 4 (Solving problems) questions. This is in keeping with the prescripts of the CAPS document.

5. Comparison with 2019 paper

We add a column to the table in 4.2 to reflect our levels of thinking for the 2019 paper.

Levels of thinking	Suggested	November 2020	November 2019
1- Knowledge	± 20%	17,3%	14,7%
2- Routine procedures	± 35%	37,4%	32,6%
3- Complex procedures	± 30%	28,0%	32,6%
4- Solving problems	± 15%	17,3%	18,7%

We note that based on our calculations for both 2019 and 2020, the Mathematics Paper 2 in 2020 appeared to be "marginally easier" than the 2019 paper, with a slight shift to level 1 and 2 questions (in percentage terms).

6. Unfair question(s):

According to teachers surveyed, there were **no unfair** questions in the paper.

7. Learners' views of the paper

Learners surveyed after the paper indicated that the paper was better than the one written in the trial examination (in one province). Some of the "stronger" learners indicated that the Analytical Geometry was "tricky", possibly due to the emphasis on fractional and decimal calculations. However, one the whole learners stated the paper was "reasonable" and most could finish on time.

8. Overall verdict

Mathematics Paper 2 appeared to be a fair paper with good coverage of the work as well as cognitive levels which were in keeping with the prescripts of the CAPS document. Learners who worked well consistently this year, especially after lockdown level 5, should have no problem in passing. The stronger learners, should have little difficulty in getting a minimum of 60% in this paper.

Notwithstanding, our comments on technical issues and the preponderance of fractional and decimal calculations, in especially, Analytical Geometry, our overall verdict for Mathematics Paper 2 is:

"A fair paper which should be accessible to most learners, with enough questions for both average and above average learners. However, those who aspire for very high marks in the paper must be able to negotiate some really high-level questions"

B. Question by question analysis

Question 1: Statistics								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
1.1	Equation of least squares regression line	3				3	1	Calculator
1.2	Draw least squares regression line		2			2		Quite tricky with use of decimals
1.3	Prediction of Physical Science mark	2				2		Use regression line
1.4	Correlation coefficient	1						Calculator work
1.5	Strength of correlation		1			1		Making a determination based on the value calculated
1.6	Observation of trend		1			1		Noting from the scatter plot/ correlation coefficient
	TOTAL	**6**	**4**			**10**		

Question 2: Statistics								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
2.1	Read off from double bar graph	1				1	1	January is a close second
2.2	Mean of data set	2				2		Calculator work
2.3	Standard deviation of data set		2			2		Calculator work
2.4	One standard deviation of the mean		3			3		Understanding needed
2.5	Choose correct statement		1			1		What does greater variation mean?
	TOTAL	**3**	**6**			**9**		

Question 3: Analytical Geometry								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
3.1	Gradient of line	2				2	2	
3.2	Prove perpendicular lines		2			2		
3.3	Calculate coordinates of S			4		4		tricky with fractions
3.4	Length of WR		4			4		Fractions again which often results in breakdown
3.5	Size of ϑ			5		5		Many different methods
3.6	Area of SWRL				4	4		
								Many may try to find coordinates of L
	TOTAL	**2**	**6**	**9**	**4**	**21**		

Question 4: Analytical Geometry								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
4.1	Equation of small circle		**2**			2	2	Use of centre (0;0) and radius
4.2	Equation of circle centre M			3		3		Not finding MT will jeopardise 4.5
4.3	Equation of NM		4			4		Fractions may result in breakdown
4.4	Length of SN			5		5		Need 4.3 to get correct y-value; fractions again
4.5	Circle with radius k				5	5		Higher order question
	TOTAL		**6**	**8**	5	**19**		

Question 5: Trigonometry								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
5.1	Period of g	1				1	3	Straightforward
5.2	Amplitude of f	1				1		Straightforward
5.3	Value of $f(180°) - g(180°)$		1			1		Could have been 2 marks
5.4.1	$f(x - 10°) = g(x - 10°)$		1			1		Values indicate more than one value for x
5.4.2	$\sqrt{3}sinx + cosx \geq 1$				4	4		Good higher question
	TOTAL	**2**	**2**		**4**	**8**		

Question 6: Trigonometry								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**		3	
6.1.1	$tan\theta$	1				1		From diagram
6.1.2	$cos\theta$	1	2			3		From diagram; get r first
6.1.3	Calculate value of b in 3rd quadrant				4	4		Quite a bit to do
6.2	Simplification of expression		5			5		Could be messy if "easiest" double angle formula not chosen
6.3	General solution			6		6		Write $\sin^2 x$ in terms of cos x
6.4	Value of cos2A				5	5		High level questions
	TOTAL	**2**	**7**	**6**	**9**	**24**		

Question 7: Trigonometry								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
7.1	Show QS = 3r	3				3		Quite tricky; division by fraction
7.2	Area in terms of r			2		2		Area of flower garden
7.3	Show RS = $r\sqrt{10-6cos2x}$			3		3		Use of cosine rule; working with variables
7.4	Calculate RS	2				2		Substitution
	TOTAL	5		5		**10**		

Question 8: Euclidean Geometry								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
8.1.1a	Size of angle O_2	2				2		Straightforward
8.1.1b	Size of angle O_1		2	2		4		Need angle K_2 first
8.1.2	Prove KN bisects angle OKP		3			3		Should follow from 8.1.1b
8.2.1	Prove FG // BC			4		4		Converse theorem
8.2.2	Calculate value of x; given that $\frac{AF}{FB}=\frac{2}{5}$; AC = 2x – 6 and GC = x + 9			4		4	4	Quite a bit to do; find AG in terms of x; then equate equal ratios
	TOTAL	**2**	**7**	**8**		**17**		

Question 9: Euclidean Geometry								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
9.1	Tan-chord theorem		5			5	4	Bookwork
9.2.1a	Angle N_2	2				2		Text instruction that QN bisects MNP was easy to miss
9.2.1b	Angle Q_2	2				2		From theorem
9.2.2	Prove $\frac{MN}{NR} = \frac{MS}{SQ}$			6		6		Work with ratios and isosceles ΔQR
	TOTAL	**4**	**5**	**6**		**15**		

Question 10: Euclidean Geometry								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
10.1.1	FBMD is cyclic		3			3	4	Ext angle = int opp angle
10.1.2	Angle B_3 = Angle F_1		4			4		$B_3 = D_2$; $D_2 = F_1$
10.1.3	ΔCDB ///Δ CBE		3			3		Routine
10.2.1	Length of BC		3			3		From similar triangles in 10.1.3
10.2.2	Length of DB				4	4		Thinking question; quite a bit to do
	TOTAL		**13**		**4**	**17**		

Summary of levels per question

Levels/ Questions	1	2	3	4	Total
1	6	4			**10**
2	3	6			**9**
3	2	6	9	4	**21**
4		6	8	5	**19**
5	2	2		4	**8**
6	2	7	6	9	**24**
7	5		5		**10**
8	2	7	8		**17**
9	4	5	6		**15**
10		13		4	**17**
Total	**26**	**56**	**42**	**26**	**150**

Overall total	**Levels**				**Marks**
	1	**2**	**3**	**4**	
All questions	26	56	42	26	150
Percentage	17,3%	37,4%	28%	17,3%	100%

5. TECHNICAL MATHEMATICS PAPER 1

A. Overall Review

1. Technical Aspects (typing; diagrams; etc)

The DBE is to be complimented on its high technical standards in Technical mathematics Paper 1. The diagrams were clear and not complicated. Questions were neatly laid out with appropriate spacing.

2. Language used

In general, the language used, in both the Afrikaans and English versions of the paper were to the point and unambiguous.

However, at times there was unnecessary use of language in questions 1; 4.3; 5.2; and 5.3. This can be to the disadvantage of candidates who struggle with reading and interpretation, especially second language learners.

3. Syllabus coverage:

Code	Content/Topic	Suggested	Actual
1	Number System	25 ($\pm$ 3)	19
2	Algebra	25 ($\pm$ 3)	34
3	Functions and graphs	35 ($\pm$ 3)	27
4	Finance, growth and decay	15 ($\pm$ 3)	16
5	Differential and Integral Calculus	50 ($\pm$ 3)	54
	TOTAL	150	150

NB: Differential Calculus includes Cubic graphs which carried 16 marks

The coverage of the content areas/topics for Technical Mathematics appears to be in line with the prescripts of the CAPS document.

4.1 Standard of paper

The paper was of a fairly high standard. It started off with an unusual question compared to previous papers and learners may have found this unnerving, especially as questions 1.1 and 1.2 were more difficult than ones which appeared in 2018/2019.

4.2 Compliance with levels of thinking

Levels of thinking	Suggested	November 2020
1 – Knowledge	± 25%	20,7%
2 - Routine procedures	± 45%	44,0%
3 - Complex procedures	± 20%	20,7%
4 - Solving problems	± 10%	14,6%

Technical Mathematics Paper 1 in 2020 appears to be more on the difficult side with 64,7% of the paper comprising level 1 (knowledge) and level 2 (routine procedures) questions (compared to the suggested 70%). This means that 35,3% of the paper (rather than 30%) comprised level 3 (complex procedures) and level 4 (solving problems) questions.

5. Comparison to 2019 paper

We add a column to the table in 4.2 to reflect our levels of thinking for the 2019 paper.

Levels of thinking	Suggested	November 2020	November 2019
1 – Knowledge	± 25%	20,7%	20%
2 - Routine procedures	± 45%	44,0%	59%
3 - Complex procedures	± 20%	20,7%	14%
4 - Solving problems	± 10%	14,6%	7%

When one looks at the above table, we note that, according to our calculations, the 2020 paper appears to be more difficult than the 2019 paper. Although more unusual questions are asked in the 2020 paper and these are not too difficult, technical mathematics learners usually have challenges with questions that require insight and analytical thinking,

6. Unfair question(s): State question(s) and indicate why the question(s) are regarded as unfair:

A list of unfair questions (for Technical Mathematics learners) is shown below:

Q1.1 Although not so difficult, it is very different from past year papers. Learners' lack of familiarity with the context would impact negatively on the way they responded. Some learners stated that they did not attempt the question.

Q1.2 Both the questions were different than normal. These questions should be easy

and straight forward to settle the learners. Learners from Mathematics are also likely to find these question unnerving and difficult.

Q4.2 Although not difficult, the learners struggle to apply the information given.

Q6.3 5 Marks for just substituting the point (-1; -1) in $g(x) = ax^2 - x$?

$$-1 = a(-1)^2 - (-1)$$
$$a = -2$$

Learners wanted to know why so many marks for such an easy calculation. However, it is possible that the examiner(s) wanted g'(x) first. In this case, g'(x) = 2ax -1. Now x = -1 means m = g'(-1) = -2a- 1. Now m = 3 so -2a-1 = 3 so a = -2

Q1.4.1 & Q5.1.1 should be allocated 2 marks each (not 1 mark each) as learners should be awarded marks, fairly, for the work they do.

7. Learners views of the paper

Learners surveyed indicated their displeasure with some of the questions (for example, 1.1; 1.2; 4.2 and 9) where a lack of familiarity of the context or not knowing what to do impacted on the way they responded to these questions.

8. Overall verdict

In coming up with our verdict for the paper, it is important to consider the mathematical background and ability of Technical Mathematics learners. These learners tend to struggle academically and choose the technical stream as they wish to work with their hands, rather than entry into one of the engineering fields. They are more interested in being artisans and so find the Technical Mathematics very difficult. Learners have previously indicated to their teachers that they do not spend much time on Technical Mathematics, preferring to put their efforts into passing Technical Science.

It is unfortunate that the preponderance of unusual, but not difficult, questions as well as those requiring complex procedures and problem solving is just too high for

Technical Mathematics learners. Some teachers responded with “What are they trying to do?” (they being the examiners)

It should be noted, and could easily be verified, that learners taking Technical Mathematics do well in all their subjects but fail Technical Mathematics dismally. Teachers report that the standard appears to be much higher than other technically oriented subjects.

We are now in a position to come up with our verdict of the paper:

“A fair paper according to content coverage and levels of thinking but possibly “unreachable” paper for a large portion of Technical Mathematics learners”

B. Question by question analysis:

Question 1: Number System and Algebra								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
1.1.1a	Outside length in terms of x	1				1	1; 2	Too much reading
1.1.1b	Outside breadth in terms of x	1				1		Too much reading
1.1.2	Total area = $4x^2+30x + 36$		2			2		Product
1.1.3	Outside length in metres		2	2		4		Should have been at the end of question 1
1.2.1	Solve for x correct to 2 dec places		3			3		Use formula
1.2.2	Inequality		1			1		Some reasoning involved
1.3	Simultaneous equations		6			6		Routine
1.4.1	Making f the subject of the formula		1			1		Should have been 2 marks
1.4.2	Numerical value of f	2				2		Routine
1.5.1	Sum of binary numbers	1				1		Calculators may be used
1.5.2	Convert to equivalent decimal number notation		2			2		Conversion
	TOTAL	**5**	**17**	**2**		**24**		

Question 2: Number System								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
2.1.1	Discriminant	2				2	1	Use delta Δ
2.1.2	Nature of roots	1				1		From the discriminant
2.2.1	In standard form	1				1		Rearranging
2.2.2	Show roots are rational	1	2			3		Use delta Δ
	TOTAL	**5**	**2**			**7**		

Question 3: Number System and Algebra								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
3.1.1	Log simplification	2	2			4	1 & 2	Straightforward
3.1.2	Surd simplification		2	2		4		A bit to do
3.2	Log equation		3	2		5		Simplify and equate
3.3.1	Total impedance	1				1		Straightforward
3.3.2	Express in cis form		4			4		Routine
3.4	Solve for k and m		4			4		Routine
	TOTAL	**3**	**15**	**4**		**22**		

Question 4: Functions and Graphs								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
4.1.1	Radius of semi-circle	1				1	3	Basic
4.1.2	Sketch graphs of line and semi-circle	2	3			5		Basic to routine
4.1.3	Domain of semi-circle	2				2		From graph
4.2	Sketch graph of hyperbola				3	3		Quite a bit to do
4.3.1a	Coordinates of T	1				1		y-intercept
4.3.1b	Coordinates of P	2				2		One point of intersection
4.3.2	Values of a and b		2	2		4		A bit to do
4.3.3	y-coordinate of R		2			2		Maximum value
4.3.4	Show $h(x) = 2^x+8$		3			3		Shifted exponential function
4.3.5	Range of h	1				1		From equation or graph
4.3.6	Length of VW			2	1	3		Need y coordinate of W first – through substitution
	TOTAL	**9**	**10**	**4**	**4**	**27**		

Question 5: Finance, Growth and Decay								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
5.1.1	Loan amount		1			1	4	Compound interest
5.1.2	Effective interest rate		3			3		Routine
5.2	Number of unskilled workers			4		4		Decrease in number
5.3.1	Investment after 2 years		2			2		Timeline
5.3.2	Final amount received				6	6		Timeline
	TOTAL		**6**	**4**	**6**	**16**		

Question 6: Differential and Integral Calculus								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
6.1	Derivative (first principles)	2	2			4	5	Basic to routine
6.2.1	Rules for derivatives	1				1		Recognition of π as a constant
6.2.2	Rules for derivatives		2	3		5		Squaring a surd
6.3	Numerical value of a				5	5		No need the derivative of g(x) first; straight substitution
	TOTAL	**3**	**4**	**3**	**5**	**15**		

Question 7: Differential and Integral Calculus								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
7.1	y-intercept of cubic graph	1				1	5	Let x = 0
7.2	x-intercept of cubic graph	2				2		Factorise
7.3	Turning points			5		5		Use derivative
7.4	Draw the graph of f (cubic graph)		4			4		Routine
7.5	Graph inequality				2	2		Graph interpretation
	TOTAL	**3**	**4**	**5**	**2**	**14**		

Question 8: Differential and Integral Calculus								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
8.1.1	Distance by car	1				1	5	From equation
8.1.2	Velocity		3			3		From derivative
8.2.1a	Height of block		1	2		3		A bit to do
8.2.1b	Volume of block		2			2		Use previous calculations
8.2.2	Maximising volume			3		3		Use 8.2.1b
	TOTAL	**1**	**6**	**5**		**12**		

Question 9: Differential and Integral Calculus								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
9.1.1	Integral of an exponent	2				2	5	Basic
9.1.2	Integral of algebraic expression		2	2		4		Routine
9.2	Shaded and unshaded areas			2	5	7		A bit to do
	TOTAL	**2**	**2**	**4**	**5**	**13**		

Summary of levels per question

Levels/ Questions	1	2	3	4	Total
1	5	17	2		**24**
2	5	2			**7**
3	3	15	4		**22**
4	9	10	4	4	**27**
5		6	4	6	**16**
6	3	4	3	5	**15**
7	3	4	5	2	**14**
8	1	6	5		**12**
9	2	2	4	5	**13**
Total	**31**	**66**	**31**	**22**	**150**

Overall total	**Levels**				**Marks**
	1	**2**	**3**	**4**	
All questions	31	66	31	22	150
Percentage	20,7%	44,0%	20,7%	14,6%	100%

6. TECHNICAL MATHEMATICS PAPER 2

A. Overall Review

1. Technical Aspects (typing; diagrams; etc)

The DBE is to be complimented on its high technical standard in the paper. The diagrams were clear, with all information visible and the font was consistent throughout the paper.

There are some minor issues:

- In question 1, the angle in the picture looks 90° but, in the diagram, it is obtuse; this may be misleading to learners.
- The use of bullets in question 2.2 enabled learners to focus on the key parts of the question. However, this was not done for other questions.
- Chord KE in Question 10.2 could have been clearer.

2. Language used

The language used in the paper should be within the grasp of all learners, especially those who are second language learners. The questions are clear and unambiguous; and the instructions easy to follow. However, candidates have to do a lot of reading.

3. Syllabus coverage

Code	Content/Topic	Suggested	Actual
1	Euclidean Geometry	40 (± 3)	37
2	Mensuration	15 (± 3)	21
3	Circles, angles and angular movement	20 (± 3)	16
4	Analytical Geometry	25 (± 3)	26
5	Trigonometry	50 (± 3)	50
	TOTAL	150	150

Technical Mathematics Paper 2 assesses 5 of the content areas/topics for the subject. The allocation for each of the content area/topics appears to be in line with the prescripts of the CAPS document.

4.1 Standard of paper

The paper is of a good standard with good content coverage and suitable for Technical Mathematics learners. The paper is cognitively balanced.

4.2 Compliance with levels of thinking:

Levels of thinking	Suggested	November 2020
1 – Knowledge	± 25%	16,6%
2 - Routine procedures	± 45%	50,7%
3 - Complex procedures	± 20%	24,00%
4 - Solving problems	± 10%	8,7%

We note that according to our calculations, 67,7% of the paper consists level 1 (Knowledge) and level 2 (Routine procedures) questions, with 32,7% comprising level 3 (Complex procedures) and level 4 (solving problems) questions. Thus, in terms of levels of thinking, we may say that the paper is cognitively balanced.

5. Comparison to 2019 paper

We add a column to our table in 4.2 to reflect our levels of thinking for the 2019 paper.

Levels of thinking	Suggested	November 2020	November 2019
1 – Knowledge	± 25%	16,6%	21%
2 - Routine procedures	± 45%	50,7%	47%
3 - Complex procedures	± 20%	24,00%	24%
4 - Solving problems	± 10%	8,7%	8%

In terms of our calculations, the 2020 compares very well with the 2019 paper. Only the ellipse question (question 2.2) was not as easy as in previous years – but this carried only 3 marks. The similarity question in Euclidean Geometry (3 marks) was easier than in the previous two years. Although the Mensuration questions were not easy, candidates were assisted with the relevant mensuration formulas (and descriptions) shown in the information sheet at the back of the question paper.

6. Unfair question(s): State question(s) and indicate why the question(s) are regarded as unfair:

Q7.1: According to the Acceptable Reasons: Euclidean Geometry in the Examination Guidelines:
In English: "Angles subtended by a chord of the circle, <u>on the same side of the chord</u>, are equal"
In Afrikaans: "Hoeke in dieselfde sirkelsegment is gelyk."
The question asked to complete the statement:
"Hoeke onderspan deur 'n koord van 'n sirkel, ….., is gelyk aan mekaar."

Teachers are encouraged to teach the reasons according to the Examination Guidelines. However, the Afrikaans learner will not recognize the statement, because of the difference in the wording on the examination guidelines.

Q9: This was a very difficult question for learners. They did not recognize the proportionality in the complicated sketch.

Q10.2: In this question learners drew extra lines and brought in a x to work through this question. They thought that there was not enough information given.

7. Learners' views of the paper

A survey of some learners after writing the paper showed that most had difficulty with the questions, which involved lots of reading. It would be fair to say that most were disappointed and are not likely to achieve high marks in the paper.

8. Overall verdict

The paper, while cognitively balanced, appeared to be quite difficult for most learners. Once again, it needs to be stated that learners who take Technical Mathematics as a subject are ones who usually do not have a good mathematical background and tend to struggle with Technical Mathematics from grade 10. For the past two years, these struggles have resulted in poor grade 12 learner performance in the subject. This is unlikely to change in 2020.

Despite our misgivings above and the possible poor performance in the subject , our verdict on the paper is:

"A fair paper, carefully set paper in terms of content and levels of thinking but likely to be beyond the reach of most Technical Mathematics learners"

B. Question by question analysis:

Question 1: Analytical Geometry								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
1.1.1	Numerical value of k	1	1			2	4	Use midpoint formula
1.1.2	Gradient of AC	2				2		Straightforward
1.1.3	Size of θ	2				2		From the gradient
1.1.4	Equation of straight line BC	1	2			3		Use gradient and one point
1.2.1	Show MO // BA		3			3		Show equal gradients
1.2.2	Show MO = ½ BA		3			3		Use distance formula
	TOTAL	**6**	**9**			**15**		

Question 2: Analytical Geometry								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
2.1.1	Diameter of circle	1	1			2	4	Use point T and the origin
2.1.2	Tangent to circle				5	5		One point of intersection
2.2.1	Equation of ellipse	1				1		Substitution
2.2.2	Graph of ellipse		3			3		Routine procedure
	TOTAL	**1**	**5**		**5**	**11**		

Question 3: Trigonometry								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
3.1	Trig ratio (use calculator)	2				2	5	Careful use of calculator
3.2.1	Trig ratio without calculator		2			2		Draw diagram in correct quadrant
3.2.2	Trig ratio without calculator		3	3		6		Draw diagram in correct quadrant
3.3.1	Simplify in terms of single ratio		3			3		Express $\cos^2 A$ in terms of sin A
3.3.2	Trig equation		3	2		5		Use 3.3.1
	TOTAL	**2**	**11**	**5**		**18**		

Question 4: Trigonometry								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
4.1.1	Trig simplification	2				2	5	Straightforward
4.1.2	Trig simplification	2	2			4		A combination of basic and routine procedures
4.2	Proof of identity			2	3	5		Quite a bit to do
	TOTAL	**4**	**2**	**2**	**3**	**11**		

Question 5: Trigonometry								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
5.1	Trig graphs	3	3			6	5	A combination of basic and routine procedures
5.2.1	Range of f	1				1		From graph
5.2.2	Period of g	1				1		From graph
5.2.3	Asymptote	1				1		From graph
5.3	Graph inequality				2	2		In-depth analyses required
	TOTAL	**6**	**3**		**2**	**11**		

Question 6: Trigonometry								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
6.1	Length of CF	1				1	5	Straightforward
6.2.1	AF (to 1 dec pl)		2			2		Use trig ratios/identities
6.2.2	Size of angle AFE			4		4		Use cosine rule
6.2.3	Area of ΔFE		3			3		Use area rule
	TOTAL	**1**	**5**	**4**		**10**		

Question 7: Euclidean Geometry								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
7.1	Complete theorem statement	1				1	1	Basic
7.2.1	Angle K_1	2				2		Opposite angles of cyclic quad
7.2.2	Angle L_2	2		3		5		Find angle O_1 first
7.2.3	Angle P_2 if angle P_3=29°			2		2		A bit to do
	TOTAL	**5**		**5**		**10**		

Question 8: Euclidean Geometry								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
8.1	Complete theorem statement	1				1	1	Basic
8.2.1	Name 4 angles = 42°	3	3			6		A combination of basic and routine procedures
8.2.2	Is OR a diameter of circle?			2		2		Find angles V_2 and V_3 first and make deduction
8.2.3	Angle Q_2 if angle V_2 = 67°		2	1		3		A combination of routine and complex procedures
	TOTAL	**4**	**5**	**3**		**12**		

Question 9: Euclidean Geometry								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
9.1	Complete theorem statement	1				1	1	Basic
9.2.1	Reasons for angle ACB = 90°	2				2		Basic
9.2.2	Why is DO // CB?	1				1		Basic
9.2.3	Length of AB		2	2		4		Combination of routine and complex procedures
9.2.4	Prove ΔABC /// ΔACE		3			3		Routine
9.2.5	Show AC^2= AB × AE		1			1		Routine
9.2.6	Length of AE			3		3		A bit to do
	TOTAL	**4**	**6**	**5**		**15**		

Question 10: Circles, Angles and Angular Movement								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
10.1.1	Size of angle AOB in radians	1				1	**3**	Radian measure
10.1.2	Convert angle AOB to degrees		2			2		Radians to degrees
10.1.3	Length of OA		2			3		Radius
10.1.4	Area of major sector AOB		3			3		Routine; need angle BOA
10.2.1	Diameter of circular path		2			3		Double the radius
10.2.2	Revolutions per minute		2			4		Use appropriate formula
	TOTAL	**1**	**15**			**16**		

Question 11: Measurement								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
11.1.1	Height of wall	1				1	2	From diagram
11.1.2	Painted area			4		4		Use mid-ordinate rule
11.1.3	Calculations of cost			3	3	6		A bit to do
11.2.1	Surface area of tank		5			5		Substitute in appropriate formula
11.2.2	Calculations to compare height				5	5		Quite a bit to do
	TOTAL	**1**	**5**	**7**	**8**	**21**		

Summary of levels per question

Levels/ Questions	1	2	3	4	Total
1	6	9			**15**
2	1	5	5		**11**
3	2	8	6	2	**18**
4	4	2	2	3	**11**
5	3	6	2		**11**
6	1	5	4		**10**
7	3	4	3		**10**
8	1	9	2		**12**
9	2	8	5		**15**
10	1	15			**16**
11	1	5	7	8	**21**
Total	**25**	**76**	**36**	**13**	

Overall total	**Levels**				**Marks**
	1	**2**	**3**	**4**	
All questions	25	76	36	13	150
Percentage	16,6%	50,7%	24,0%	8,7%	

7. MATHEMATICAL LITERACY PAPER 1

A. Overall Review

1. Technical Aspects (typing; diagrams; etc)

The paper was technically good with clear diagrams, well spaced-out text and key information (stimulus) given in text-boxes.

It was suggested that 1.3 could have also been included in the Addendum (as one of the annexures)

2. Language used

There were no language challenges in the paper. The language used should be within the grasp of most grade 12 Mathematical Literacy learners.

Question 5.1.1 had some ambiguity: Is it the team's combined score for the vault event or the individual with the highest score for the event.

3. Syllabus coverage

Code	Content areas (contexts)	Suggested	Actual
1	Finance	53 ± 8	54
2	Measurement	30 ± 8	24
3	Maps, plans and other representations	22 ± 8	25
4	Data Handling	38 ± 8	37
5	Probability	Min 7	10
	TOTAL	**150**	**150**

The coverage of the 5 content areas (contexts) for the paper was adequate, although Measurement appears on the "low side"; but still within the range.

4.1 Standard of paper

The paper is a typical Mathematical Literacy Paper 1, with adequate coverage of the content area and contexts. The paper should be within the grasp of most learners and is, thus, of an acceptable standard.

4.2 Compliance with levels of thinking

Levels of thinking	Suggested	November 2020
1 – Knowledge	60% (± 5)	53%
2 - Routine procedures	35%(± 5)	37%
3 – Multi-step procedures	5% (minimum)	9%
4 – Reasoning and analysis	0%	-

According to our calculations, the allocations the levels of thinking for this paper appear to be within the range expected. Our calculations for knowledge questions seems to be slightly lower than expected but this should not detract from what is a "top quality paper".

5. Comparison with 2019 paper

We add a column to our table in 4.2 to show our levels of thinking for 2019.

Levels of thinking	Suggested	November 2020	November 2019
1 – Knowledge	60% (± 5)	53%	56%
2 - Routine procedures	35%(± 5)	37%	39%
3 – Multi-step procedures	5% (minimum)	9%	5%
4 – Reasoning and analysis	0%	-	

From the levels of thinking shown in the above table, the 2020 paper compares very favourably to the 2019 paper. However, according to our calculations, it would appear that level 3 (multi-step procedures) questions were slightly higher, making the 2020 slightly more difficult.

Teachers also noted the following:

- Questions appeared to be less ambiguous requiring interpretations to be confined (and not open to any view by candidates)
- The questions were more learner friendly; most learners should do well
- The paper was an ideal Mathematical Literacy paper 1

6. Unfair question(s): State question(s) and indicate why the question(s) are regarded as unfair:

Although there were no questions which could be regarded as unfair, teachers noted the following:

Calculating the monthly tax payable before rebates are deducted in question 2.2.3 is a change from how this question has been set in previous paper. Usually learners write down everything including rebates when responding to questions of this nature. Thus, they have to read carefully and understand the requirements of the question.

7. Learners view of paper:

Most learners surveyed after the writing of the paper stated that the paper was “fair” and a good paper in which to score high marks in the subject.

8. Overall verdict

We note that the paper was a typical Mathematical Literacy Paper 1, with no issues.

Our verdict is, thus:

“A fair, well-set, learner friendly and manageable paper with no “twists” or “turns”..

B. Question by question analysis

Question 1: Data Handling, Finance and Maps, Plans and other Representations								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
1.1.1	Data Handling	2				2	1; 3; 4	Type of graph
1.1.2	Data Handling	2				2		Restaurant menu A
1.1.3	Data Handling	2				2		Mr Delivery B
1.1.4	Data Handling	2				2		Difference between highest and lowest price; give one mark if wrong bar used
1.1.5	Data Handling	2				2		Increase in delivery fee
1.2.1	Finance	2				2		Year diesel > petrol
1.2.2	Finance	3				3		Difference in price (2 years)
1.2.3	Finance	3				3		Ratio of diesel price (two years) to 2 dec places
1.2.4	Finance	2				2		Cost of 13,45 litres of petrol in 2003
1.2.5	Finance	2				2		Difference less than 5 cents
1.3.1	Maps, plans and other representations	2				2		Type of map
1.3.2	Maps, plans and other representations	2				2		Actual distance
1.3.3a	Maps, plans and other representations	2				2		Towns passing through
1.3.3b	Maps, plans and other representations	2				2		Distance from Riversdale to Oudtshoorn
	TOTAL	**30**				**30**		

Question 2: Finance								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
2.1.1	Finance	2				2	1	Balance owing; two options given; learners could choose second one
2.1.2	Finance	2				2		Full date
2.1.3	Finance	2				2		Opening balance
2.1.4	Finance	2				2		Price of item returned
2.1.5	Finance	3				3		Amount paid using FNB electronic payments
2.1.6	Finance		3			3		Price excluding VAT
2.2.1	Finance	2				2		Name of govt institution
2.2.2	Finance	2				2		Tax bracket
2.2.3	Finance			5		5		Monthly tax payable
2.2.4a	Finance	2				2		Tax rebate for Dean
2.2.4b	Finance	2				2		Tax rebates for 75 year old man
2.3.1	Finance	2				2		Selling price of one photograph
2.3.2	Finance		2			2		Formula for income received
2.3.3a	Finance	2				2		Variable cost
2.3.3b	Finance		3			3		Missing value A
2.3.4a	Finance	2				2		Suitable heading
2.3.4b	Finance	2				2		Choosing appropriate graph
2.3.4c	Finance		2			2		Break even
	TOTAL	**27**	**10**	**5**		**42**		

Question 3: Measurement								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
3.1.1	Measurement	3				3	2	Number of legs
3.1.2	Measurement	2				2		Radius of legs
3.1.3	Measurement		2			2		Height of ottoman
3.1.4	Measurement			5		5		Surface area to be painted
3.1.5	Measurement			4		4		Quantity of paint required
3.1.6	Measurement		3			3		Height of paint tin
3.2.1	Measurement		4			4		Missing items a and b
3.2.2	Measurement		3			3		Probability of not selecting red material
3.3.1	Measurement		2			2		Convert inch to cm
3.3.2	Measurement		3			3		Perimeter of one large sheet
	TOTAL	**5**	**17**	**9**		**31**		

Question 4: Maps, Plans and other Representations								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
4.1.1	Maps, plans and other representations	2				2	3	Identify road
4.1.2	Maps, plans and other representations	2				2		Type of scale
4.1.3	Maps, plans and other representations		2			2		General direction
4.1.4	Maps, plans and other representations		2			2		Distance from Wellington to Tulbagh (from table); Learners who measure should be given the marks
4.1.5	Maps, plans and other representations	2				2		Name of town (from directions)
4.2.1	Maps, plans and other representations		3			3		Minimum length
4.2.2	Maps, plans and other representations		4			4		Calculate distance D; Learners might miss the key, should have put it in the text above
	TOTAL	**6**	**11**			**17**		

Question 5: Data Handling								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
5.1.1	Data Handling	2				2	4; 5	Team with highest score for vault event
5.1.2	Data Handling	2				2		Range of G Gilliland's score
5.1.3	Data Handling		3			3		Mean score for bar event
5.1.4	Data Handling	3				3		Missing value A
5.1.5	Data Handling	2				2		Modal score
5.1.6	Probability		3			3		Probability as a percentage
5.1.7	Data Handling		3			3		Quartile 2 for floor event
5.2.1	Data Handling	2				2		Population in words
5.2.2	Data Handling		3			3		Population increase
5.2.3	Data Handling		3			3		Annual population growth
5.2.4	Data Handling		4			4		Draw graph for 2018
	TOTAL	**11**	**19**			**30**		

Summary of levels per question

Levels/ Questions	1	2	3	4	Total
1	30				**30**
2	27	10	5	-	**42**
3	5	17	9		**31**
4	6	11			**17**
5	11	19			**30**
Total	**79**	**57**	**14**		**150**

Overall total	**Levels**				**Marks**
	1	**2**	**3**	**4**	
All questions	79	57	14	-	150
Percentage	53%	38%	9%		

8. MATHEMATICAL LITERACY PAPER 2

A. Overall Review

1. Technical Aspects (typing; diagrams; etc)

The paper was technically good with clear diagrams, well spaced-out text and key information (stimulus) given in text-boxes. Font sizes were big enough to make reading comfortable.

2. Language used

The language used in the paper should be within the grasp of most Mathematical Literacy learners. Although there was a lot of reading to do, the wording was clearly unambiguous and easy to understand.

3. Syllabus coverage

Code	Content areas (contexts)	Suggested	Actual
1	Finance	53 ± 7	50
2	Measurement	30 ± 7	32
3	Maps, plans and other representations	23 ± 7	18
4	Data Handling	37 ± 7	41
5	Probability	Min 7	9
	TOTAL	**150**	**150**

The coverage of the 5 content areas (contexts) for the paper was adequate and , although Maps, plans and other representations appears on the “low side”, it still within the range.

4.1 Standard of paper

It was a typical Mathematical Literacy Paper 2, consisting of several unfamiliar scenarios which is evident of the current Paper 2 requirements. The paper was well set, fair and a very good standard.

4.2 Compliance with levels of thinking

Levels of thinking	Suggested	November 2020
1 – Knowledge	0%	0%
2 - Routine procedures	± 25%	28%
3 – Multi-step procedures	± 35%	35%
4 – Reasoning and analysis	± 40%	37%

5. Comparison with 2019 paper

We add a column to the table in 4.2 to show our levels of thinking for the 2019 paper.

Levels of thinking	Suggested	November 2020	November 2019
1 – Knowledge	0%	0%	0%
2 - Routine procedures	± 25%	28%	26%
3 – Multi-step procedures	± 35%	35 %	37 %
4 – Reasoning and analysis	± 40%	37%	37%

According to our calculations, the levels of thinking expected in the 2020 paper was very similar to the 2019.

6. Unfair question(s): State question(s) and indicate why the question(s) are regarded as unfair:

There were no questions in the paper which could be regarded as "unfair". It was a typical Mathematical Literacy Paper 2 where the emphasis was on higher level thinking.

7. Learners views of the paper

On the whole, learners expected the paper to be more difficult than paper 1 and thus prepared accordingly. While most learners were able to negotiate the copious amount of reading and interpretation required in the paper, a number of learners reported that question 2 was "quite challenging". .

8. Overall verdict

Mathematical Literacy is a relatively new subject in South Africa, have been introduced in our schools as recently as 2006 (grade 10). Most teachers who teach this subject have been doing so from those early days. They know exactly what to teach in this subject, and how to teach the "what". Their grade 12 learners have had 3 years experience in the subject and would be very familiar with the requirements of Mathematical Literacy paper 2 . These learners should have no problem passing this paper, provided they put in the necessary effort in the subject, especially since 2020 has been a very disruptive year for learners and teachers alike.

Our verdict of the paper is, thus:

A well-planned and interesting paper with some new scenarios to challenge the learners' thinking in an acceptable and meaningful way.

B. Question by question analysis:

Question 1: Data Handling; Probability, Finance, and Measurement								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
1.1.1	Data Handling		3			3	4;5; 1; 2	Difference in learner numbers
1.1.2	Data Handling		3			3		Value of N
1.1.3	Data Handling				2	2		Trend of learner numbers in Greece
1.1.4	Data Handling			6		6		Percentage increase comparison with calculations
1.1.5	Probability		3			3		Probability as a decimal fraction
1.1.6	Finance				6	6		Verification of statement on cost per child
1.2.1	Finance			4		4		Selling price of each marble
1.2.2	Measurement				9	9		Verification of statement with calculations
1.2.3	Measurement			3		3		Outer circumference of cylindrical container
	TOTAL		**9**	**13**	**17**	**39**		

Question 2: Finance and Measurement								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
2.1.1	Finance		3			3	1; 2	Amount claimed by CM and IM
2.1.2	Finance		2			2		Value of A from table
2.1.3a	Measurement			6		6		Expected time and day for marking completion
2.1.3b	Finance			4		4		Actual day when markers finished
2.1.3c	Measurement				2	2		Reason for finishing before time
2.1.4	Finance				6	6		Verification with calculations
2.2.1	Measurement				8	8		Verification – validity of statement
2.2.2	Finance			7		7		Total cost with VAT
	TOTAL		**5**	**17**	**16**	**38**		

Question 3: Probability, Data Handling, Finance and Maps, Plans and other Representations								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
3.1.1	Data handling				3	3	4; 5; 3; 1	Nature of data
3.1.2	Data handling		3			3		Median score
3.1.3	Data handling			4		4		Value of Y (from scores)
3.1.4	Data handling		3			3		Difference of 30% in scores
3.1.5	Data handling			4		4		Interquartile range for test 2
3.1.6	Probability		3			3		Probability in simplified fraction form
3.1.7	Data handling		2			2		Modal test score
3.2.1	Maps, plans and other representations		2			2		Road – no parking allowed
3.2.2	Maps, plans and other representations				2	2		Reason for no right turn
3.2.3	Maps, plans and other representations		2			2		General direction
3.2.4	Maps, plans and other representations			4		4		Straight line distance use scale on map
3.2.5a	Maps, plans and other representations		2			2		Name of offense
3.2.5b	Finance			5		5		Rate per hour for fine
	TOTAL		**17**	**17**	**5**	**39**		

Question 4: Probability; Data Handling, Finance and Maps, Plans and other Representations								
Quest.	**Content**	**Levels**				**Marks**	**Topic Code**	**Comment**
		1	**2**	**3**	**4**			
4.1.1	Probability			3		3	5; 3; 1; 4	Probability as a percentage
4.1.2	Maps, plans and other representations		2			2		Row and seat number
4.1.3	Maps, plans and other representations				4	4		Shortest possible path
4.1.4	Finance				6	8		Verification with calculations
4.1.5	Finance			3		3		Exchange rates
4.2.1	Data handling		5			5		Completion of missing bars
4.2.2	Data handling			3		3		Comparison of inflation rate
4.2.3	Finance				6	6		Verification with calculations
	TOTAL		**7**	**9**	**18**	**34**		

Summary of levels per question

Levels/ Questions	1	2	3	4	Total
1		9	13	17	**39**
2		5	17	16	**38**
3		17	17	5	**39**
4		7	9	18	**34**
Total		**38**	**56**	**56**	**150**

Overall total	Levels				Marks
	1	**2**	**3**	**4**	
All questions	-	38	56	56	150
Percentage	-	25,3%	37,3%	37,3%	100%

9. CONCLUSION

AMESA is proud to be associated with the review of grade 12 Mathematics/Technical Mathematics/Mathematical Literacy. These are key subjects and it is important for teachers to be knowledgeable about the assessment processes in these subjects.

In this regard, the discussions and deliberations about the grade 12 examination papers in the various AMESA regions of South Africa has given teachers the opportunity of being involved in this key teacher development activity where they were able to analyse and interrogate these important end-of-year assessments.

We would like to compliment the various DBE examiners and moderators as well as UMALUSI for providing South African learners with assessments which were set in accordance with the curriculum and subject assessment guidelines. While we recognise efforts to make the Technical Mathematics papers more accessible to learners, we believe that there is a mismatch between the Technical mathematics curriculum and the type of learners doing the subject. Learner performance in Technical Mathematics is unlikely to improve in the short term if the Technical Mathematics curriculum remains unchanged. In this regard, we propose PAT (Practical Assessment Task) for Technical Mathematics, which is linked or related to the technical field taken by learners.

AMESA believes that learners who were taught well should have no problem in passing these various Mathematics related papers. We note that there were lots of efforts in the various provinces to ensure that learners, especially from schools in less affluent areas, pass these and other subjects at a more acceptable level, rather than the minimum 30%. .

However, learning does not begin in grade 12. Rather, grade 12 is the culmination of all the efforts which have been put in over the years. Thus, it is important to keep track of learner performance from the earlier grades so that the necessary interventions can be made very early in a learner's schooling career and not in grade 12.

AMESA is a key role player in Mathematics Education and is able to interact with its members on an informed basis, for the betterment of Mathematics Education in South Africa. The review of the grade 12 Mathematics related examination papers by mathematics teachers in a workshop situation is one such activity which could contribute to improved teaching and learning in South African schools.

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