



RADMASTE Centre  
Private Bag 3  
WITS  
2050

Tel: 011 717 3461  
Fax: 011 717 3459  
Cell: 083 9600 626  
Email: [president@amesa.org.za](mailto:president@amesa.org.za)

**12 December 2009**

**Mr Edward Mosuwe  
Chief Director: Further Education and Training: Schools  
Department of Basic Education  
Sol Plaatjie House  
123 Schoeman Street  
PRETORIA**

Dear Edward

**Re: Submission of Grade 12 Mathematics and Mathematics Literacy Papers 1 & 2**

On behalf of the Association for Mathematics Education of South Africa (AMESA) I would like to make a submission to the Department of Basic Education on the analyses of the 2009 Grade 12 Mathematics and Mathematics Literacy Papers 1 & 2.

The purpose of this report is to provide effective feedback to the Department of Basic Education on the Grade 12 Mathematics and Mathematics Literacy 2009 examination. It is our wish to work in partnership with the department in the promotion of Mathematics education and, in the enhancement of the quality of the teaching and learning of Mathematics in South Africa.

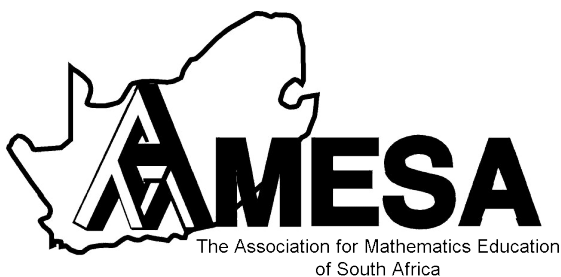
Please find attached the composite report drawn up from the comments submitted by our regional curriculum committees together with the Western Cape analyses which came in late to can be incorporated into the composite report.

For further information on AMESA, please see our website at <http://www.amesa.org.za>, and for further information on our congress 2010 please see <http://www.amesa.org.za/AMESA2010/>.

Should you need any further information, please do contact me. I am looking forward to hearing from you.

Sincerely

Elspeth Mmatladi Khembo  
AMESA National President



RADMASTE Centre  
Private Bag 3  
WITS  
2050

Tel: 011 717 3461  
Fax: 011 717 3459  
Cell: 083 9600 626  
Email: [president@amesa.org.za](mailto:president@amesa.org.za)

## REPORT OF THE AMESA CURRICULUM COMMITTEE ON THE 2009 SENIOR CERTIFICATE MATHEMATICS AND MATHEMATICAL LITERACY PAPERS

### Introduction

1. On the conclusion of the Senior Certificate Mathematics and Mathematical Literacy Papers several AMESA regions and branches arranged meetings at which they analysed the various papers. Responses were recorded and submitted to the AMESA National Council. Subsequent to the preparation of this single document one further substantive submission was made by the AMESA (Western Cape) region. Rather than incorporating the Western Cape submission into the earlier report, the two sets of reports are provided here.
2. The detailed reports are provided as appendixes as follows:

- Appendix A: AMESA Composite Report: 2009 SC Mathematics Paper 1
- Appendix B: AMESA Composite Report: 2009 SC Mathematics Paper 2
- Appendix C: AMESA (Western Cape) Report: 2009 SC Mathematics Paper 1
- Appendix D: AMESA (Western Cape) Report: 2009 SC Mathematics Paper 2
- Appendix E: AMESA Composite Report: 2009 SC Mathematical Literacy Paper 1
- Appendix F: AMESA Composite Report: 2009 SC Mathematical Literacy Paper 2

### Analysis of the Mathematics papers in terms of their cognitive demand

3. All of the reports (with some acceptable variance) suggest that Mathematics Paper 1 did not have sufficient questions at the Knowledge level of the assessment taxonomy – this may lead to a large number of learners who should have passed not having done so.

<b>Taxonomical Categories</b>	<b>Exam Guidelines (%)</b>	<b>AMESA Composite (%)</b>	<b>AMESA Western Cape (%)</b>
Knowledge	±25	10	4,7
Performing Routine procedures	±30	42,67	47,7
Performing Complex Procedures	±30	32,67	31,3
Problem Solving	±15	14,67	17,3

4. All of the reports (again with some acceptable variance) suggest that Mathematics Paper 2 was better balanced in terms of cognitive demand.

<b>Taxonomical Categories</b>	<b>Exam Guidelines (%)</b>	<b>AMESA Composite (%)</b>	<b>AMESA Western Cape (%)</b>
Knowledge	+25	24	20
Performing Routine procedures	+30	28,7	37
Performing Complex Procedures	+30	32	22
Problem Solving	+15	15,3	21

### **Analysis of the Mathematics papers in terms of their curriculum coverage**

5. All of the reports suggest that the Mathematics examination papers were set in line with the Subject Assessment Guidelines in terms of the distribution of marks to the different Learning Outcomes.

### **Overall observation with respect to Mathematics**

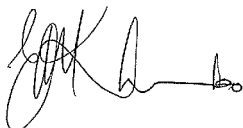
6. The general sense that emerges through the various reports is that the 2009 examination papers were substantially more demanding than the 2008 papers and that, in particular, Paper 1 did not provide sufficient questions at the lower level of the Assessment Taxonomy.

### **Mathematical Literacy**

7. The regions were less vocal with regard to Mathematical Literacy and the general sense is that the subject and its examination is still settling in and defining itself and was found to be at an acceptable standard. That noted, there was also a feeling that the 2009 examination papers represented an improvement on the 2008 versions.

### **Conclusion**

8. It is the hope of the Association that these comments, and in particular the question by question analyses found in Appendixes, will be helpful to the Examiners, Markers and Moderators as well as to the Department of Education in general.



Elspeth Khembo  
AMESA President  
12 December 2009

## APPENDIX A

### AMESA Composite Report: 2009 SC Mathematics Paper 1

In terms of AMESA's vision and goals, the purpose of this report is to provide effective feedback to the Department of Education on the following aspects regarding grade 12 examinations in mathematics:

- The cognitive demand of the examination papers with special reference to:
  - Content coverage and Content relevance
  - Difficulty levels of questions.
- Compliance with Policy and Assessment and Exam Guidelines
- Language
- Fairness

In developing this report, written inputs from the provinces were considered to provide effective feedback in terms of the following format:

- Cognitive levels, Learning Outcomes and Assessment standards
- Language
- Fairness
- General comments
- Recommendations
- Specific comments per question
- Conclusion

#### 1. Cognitive levels, Learning Outcomes and Assessment Standards.

##### 1.1 Analysis of Mathematics Gr 12 Paper I November 2009

Q	LO's	A.S's	Topic	Marks	Knowledge ± 25% 37,8 marks	Routine procedures ± 30% 45 marks	Complex procedures ± 30% 45 marks	Problem Solving ± 15% 22,5 marks
1.1.1	LO1	10.2.5	Quadratic equation by factorisation	3	3			
1.1.2	LO1	11.2.5	Quadratic formulae	4	4			
1.1.3	LO1	11.2.5	Quadratic inequalities	4		4		
1.2	LO1	11.2.5	Equations in two unknowns	5		5		
1.3	LO1	10.2.4	Factorisation	3				3
1.4	LO1	10.2.4	Squaring a binomial	3			3	
2.1	LO1	12.1.3a	Arithmetic and geometric sequences	5			5	
2.2	LO1	12.1.3a	Arithmetic and geometric sequences	5				5
3	LO1	12.1.3b	Sigma notation	5	1	4		
4.1	LO1	11.1.3	Quadratic number pattern	3		3		
4.2	LO1	11.1.3	Quadratic number pattern	2		2		
4.3	LO1	11.1.3	Quadratic number pattern	4			4	
4.4	LO1	11.1.3	Quadratic number pattern	2				2

Q	LO's	A.S's	Topic	Marks	Knowledge ± 25% 37,8 marks	Routine procedures ± 30% 45 marks	Complex procedures ± 30% 45 marks	Problem Solving ± 15% 22,5 marks
5.1	LO1	12.1.3c	Geometric sequences	2		2		
5.2	LO1	12.1.3c	Geometric sequences	3			3	
5.3	LO1	12.1.3c	Geometric sequences	3				3
6.1	LO2	11.2.2	Parabola & Hyperbola	6			6	
6.2	LO2	11.2.2	Parabola & Hyperbola	2		2		
6.3	LO2	11.2.2	Parabola & Hyperbola	2		2		
6.4	LO2	11.2.2	Parabola & Hyperbola	3				3
7.1	LO2	11.2.2	Trigonometric graphs	1	1			
7.2	LO2	11.2.2	Trigonometric graphs	3		3		
7.3	LO2	11.2.2	Trigonometric graphs	2			2	
7.4	LO2	11.2.2	Trigonometric graphs	2			2	
8.1	LO2	12.2.2	Log graph	1	1			
8.2	LO2	12.2.2	Log graph –inverse	1		1		
8.3	LO2	12.2.2	Log graph -inverse	1	1			
8.4	LO2	12.2.2	Log graph	4				4
8.5	LO2	12.2.2	Log graph	3		3		
9.1	LO2	12.1.4a	Depreciation on a reduced balance (n)	4		4		
9.2	LO2	12.1.4b	Finance - repayments	12	2		10	
10.1	LO2	12.2.7a	Derivative from first principles	5		5		
10.2	LO2	12.2.7b	Rules of differentiation	2		2		
11.1	LO2	12.2.4	Factorise third-degree polynomials	5		5		
11.2	LO2	12.2.7d	Stationary points	5		5		
11.3	LO2	12.2.7d	Sketch graphs	3		3		
11.4	LO2	12.2.7d	Points of inflection	2		2		
11.5	LO2	10.3.4	Translation downward	2			2	
12.1	LO2	12.2.7e	Rates of change	2	2			
12.2	LO2	12.2.7e	Rates of change	3		3		
12.3	LO2	12.2.7e	Rates of change	2				2
12.4	LO2	12.2.7e	Rates of change	3			3	
13.1	LO2	12.2.8	Linear programming	7			7	
13.2	LO2	12.2.8	Linear programming	2			2	
13.3	LO2	12.2.8	Linear programming	2		2		
13.4	LO2	12.2.8	Linear programming	2		2		
			<b>Total</b>	<b>150</b>	<b>15</b>	<b>64</b>	<b>49</b>	<b>22</b>
			<b>%</b>		<b>10%</b>	<b>42,67%</b>	<b>32,67%</b>	<b>14,67%</b>

## 1.2 Comparison of cognitive level percentages between exam guidelines and actual written examination paper

Taxonomical Categories	Exam Guidelines (%)	Exam Paper 1 (%)
Knowledge	+25	10
Performing Routine procedures	+30	42,67
Performing Complex Procedures	+30	32,67
Problem Solving	+15	14,67

From the above table,

- Certainly there is a distinct imbalance between knowledge and performing routine procedures levels. The paper has too much weight on level 2 questions and less on level 1. There were too few Level 1 questions for the weaker learners who have difficulty even achieving 30%.
- There is a reasonable balance amongst the higher order levels. However the nature of and structure of the higher order problems demands that the learner spend lots of time to read and understand the problem/question, and subsequently devise a plan to solve the given problem before he or she proceeds to attempt to solve the problem or answer them. This may result in many candidates not finishing the paper within the given time.

## 1.3 Mark distribution for topics in Mathematics Paper 1

LO	Description	Recommended marks	P 1: Nov 2009
1	Patterns & Sequences	± 30	34
1	Finance	± 15	16
2	Functions & graphs	± 35	31
2	Algebra and Equations (and inequalities)	± 20	22
2	Calculus	± 35	34
2	Linear Programming	± 15	13
	<b>TOTAL</b>	<b>150</b>	<b>150</b>

- The paper spread in terms of topics is in line with the weighting given in the examination guidelines. However, more than 50% of the marks have been allocated to grade 11 work. Our recommendation is that a greater percentage should be set on grade 12 work.

## 2. Language

- The overall feeling is that the use of language was acceptable, particularly for the home language learners.
- However, second language learners may experience difficulty with the wording of Q 2.1, Q5, and Q13.

## 3. Fairness

- The overall feeling is that the paper was not all that fair, primarily because there is too much deviation from previous question paper all of a sudden. However, on the other hand it has many advantages, in that it clearly signals to educators that they must not just teach to exemplars and previous exam papers but rather teach the curriculum thoroughly.
- In some instances like in Q10.1, the assessment standards were not adhered to.
- The process of raising the level of difficulty should have been a gradual process over the next two to three years. There were many “explain”, “Show that”, “Interpret”, questions.

- The following questions are challenging to the majority of candidates 1.3, 1.4, 2.2, Q3 (using  $t = 0$ ), 4.2, 4.4, 5.3, 6.1, 6.4, Q8 (original graph is negative) and questions are based on graphs not on sketch, 9.2, Question 11 (again – negative graph), Question 12 (this type of question favours the science candidates).
- The mark allocation of the easy “bread and butter” questions was also reduced compared to that of previous years.
- Many questions were asked in a contextual form, which were high level questions that demand high cognitive level of learners.
- In four instances learners had to find the expression for the general term of a sequence (3 times Linear and 1 Quadratic).

#### 4. General comments

- In comparison to the previous year, the structure was the same, but the types of questions were quite different and definitely more challenging and of a higher level than last year.
- The standard of the paper was much higher compared to 2008. The jump in the standard in one year’s time is very high.
- A large number of questions and problems are beyond majority of learners.

#### 5. Recommendations

- Examiners must consider the length (duration) of the paper when setting contextual problems that require sufficient time to be read, understood, and solved.
- The assessment standards must be properly interrogated against each examination item.
- Examination papers should provide a reasonable opportunity for the weaker learners to score at least 30%.
- Cognitive levels must always be balanced as per policy requirements.
- More marks should be weighted towards grade 12 work than grade 11 work.

#### 6. Comments on all questions in the November 2009 Mathematics Paper 1

##### Question 1

Question relates to grade 11 work

Questions 1.1 & 1.2 - these questions were standard and easy, but Q1.3 was difficult for most learners and was allocated too few marks (only 3). Q1.4 however was also a higher order question which required careful manipulation.

##### Question 2

2.1 Questions relate to grade 11 work

Although these questions were easy, careful note must be taken that the  $n$ th term,  $T_n = (4n+1) + (n-1)(n-2)(n-3)(n-4)(n-5)$  (anything in  $n$ ), also satisfies Mathew’s sequence.

2.2 Question relates to Grade 12 work.

Although this question relates to grade 12 work, it must be noted that educators will generally not teach the sum to ' $n$ ' terms of the geometric series which is not defined for  $r = 1$  (see assessment standards). Hence, many learners will not understand the question.

##### Question 3

Questions relate to grade 11 work

This question is of an acceptable standard.

**Question 4**

Questions relate to grade 11 work.

Questions 4.1 – 4.4 are inclined to be difficult for the majority of learners, because of the style in which they are phrased. More, importantly the grade 12 Curriculum is very clear that the focus should be on AP's and GP's. It seems that the exam guideline is wrongly interpreting the assessment standards.

**Question 5**

Question relates to grade 12 work.

This is a difficult question for most learners. It is a replica of a previous HG problem.

**Question 6**

Questions relate to grade 11 & 12 work. It is a good question although Q6.4 demanded a great deal of work and effort for very few marks.

**Question 7**

Question relates to grade 11 work.

This was a standard question on trig graphs. This question should be placed in Paper 2, particularly if we expect learners to use the reference angle to determine other coordinates (see Q7.2).

**Question 8**

This question relates to grade 12 work

Given  $f(x) = -\log_2 x$ , most learners would have been unaware that  $-\log_2 x = \log_{\frac{1}{2}} x$  as logs are

no longer a major topic in the curriculum. They feature simply as stated "to demonstrate an understanding of the definition of logarithm, and any laws needed to solve real life problems".

Giving the function in the form  $f(x) = -\log_2 x$  would have stopped learners in their tracks and most would not have known where to begin.

Q8.5 was a log inequality, which is also not included in the NCS curriculum. Furthermore it was a L4 question, and was therefore unfair.

**Question 9**

This question relates to grade 10 & 12 work

The financial mathematics questions were worded in such a way making it not easy to understand what was required, adding to the difficulty.

In particular, Q9.2 was unfair. Why is it necessary to give a poor hint in the form of 9.2.1 ?

Methodology must not be prescribed. Those learners who knew how to solve the problem may have been confused. The problems are unnecessarily wordy. In both cases there were 54 instalments.

Why mention 53?

**Question 10**

This question relates to grade 12 work.

Q10.1 is not aligned to the assessment standard. Every learner must be awarded 5 marks.

In Q10.2 too few marks ( 2 marks) are allocated for the application of the rules for differentiation.

This is unfair in terms of the amount of teaching time spent on this aspect.

**Question 11**

This question relates to grade 12 work and was reasonably fair,

**Question 12**

This question relates to grade 12 work and was of a higher order type.

The question required a lot of reading in order to understand what was required.



**Question 13**

This question relates to grade 11 work, but is not easy more so because it was asked in a different form to those in the exemplars. However 13.4 was a higher order question (L4) and very few learners will get this correct.

**7. Conclusion**

Generally most teachers consulted thought the paper was much more difficult than the 2008 paper, the 2009 supplementary paper and all the exemplars. Whilst this is good practice, it must be noted that there are some questions which are similar to previous higher grade questions and some are beyond the requirements of the assessment standards. Most certainly this paper will allow for clear differentiation of performance amongst learners, particularly the high flyers.

## APPENDIX B

### AMESA Composite Report: 2009 SC Mathematics Paper 2

In terms of AMESA's vision and goals, the purpose of this report is to provide effective feedback to the Department of Education on the following aspects regarding grade 12 examinations in mathematics:

- The cognitive demand of the examination papers with special reference to:
  - Content coverage and content relevance
  - Difficulty levels of questions.
- Compliance with Policy and Assessment and Exam guidelines
- Language
- Fairness

In developing this report, written input from the provinces were considered to provide effective feedback in terms of the following format:

- Cognitive levels, learning outcomes and Assessment standards
- Language
- Fairness
- General comments
- Recommendations
- Specific comments per question
- Conclusion

#### 1. Cognitive levels, Learning Outcomes and Assessment Standards.

##### 1.1 Analysis of mathematics Gr 12 Paper 2 November 2009

Q	LO's	A.S's	Topic	Marks	Knowledge ± 25% 37,8 marks	Routine procedures ± 30% 45 marks	Complex procedures ± 30% 45 marks	Problem Solving ± 15% 22,5 marks
1	LO4	11.4.1a	Five number summary; Box & whisker diagrams; Standard deviation.	15	7	3	3	2
2	LO4	11.4.1b	Scatter plot	8	4			4
3	LO4	11.4.1a	Ogives	5	1	1	3	
4.1	LO3	10.3.3b	Gradient	2	2			
4.2	LO3	10.3.3b	Solve for unknown using gradient formula	2		2		
4.3	LO3	10.3.3b	Solve for unknown using distance formula	4		4		
4.4	LO3	10.3.3b	Midpoint	2	2			
4.5	LO3	11.3.3b	Equation of a line through one point parallel to a given line.	3		3		
5.1	LO3	12.3.3a	Equation of a circle	2	2			
5.2	LO3	12.3.3b	Equation of a tangent	1	1			
5.3	LO3	12.3.3b	Equation of a tangent	5			5	
5.4	LO3		Distance formula	4	4			

Q	LO's	A.S's	Topic	Marks	Knowledge ± 25% 37,8 marks	Routine procedures ± 30% 45 marks	Complex procedures ± 30% 45 marks	Problem Solving ± 15% 22,5 marks
5.5	LO3	11.3.3b	Perpendicular lines	3		3		
5.6 - 5.7	LO3	12.3.310 .3.2	Gradient of a radius and a tangent Properties of a Kite	7	1		6	
6.1.1	LO3	12.3.4b	Transformation Geometry: Area	2	2			
6.1.2- 6.1.4	LO3	12.3.4b	Transformation Geometry: Enlargement	7	2	5		
6.2	LO3	12.3.4b	Reflection; Rotation; Translation	6			6	
7	LO3	12.3.4a	Rotation anti-clockwise through 135 degrees	11	4		7	
8	LO3	12.3.5	Pythagorean trigonometric problem	8		5	3	
9	LO3	11.3.5a b c d	Reduction patterns; Special angles; Equations	21		14	7	
10	LO3	12.3.5	Compound angle identities	7				7
11.1.1	LO3	11.3.5e	Compass bearing	6			6	
11.1.2	LO3	11.3.5e	Compass bearing	3				3
11.2	LO3	11.3.5e	Cosine rule	4				4
12	LO3	11.2.2	Trigonometric graphs	12	4	3	2	3
			<b>Total</b>	<b>150</b>	<b>36</b>	<b>43</b>	<b>48</b>	<b>23</b>
			<b>%</b>		<b>24%</b>	<b>28,67%</b>	<b>32%</b>	<b>15,33%</b>

## 1.2 Comparison of cognitive level percentages between exam guidelines and actual written examination paper

Taxonomical Categories	Exam Guidelines (%)	Exam Paper 2 (%)
Knowledge	<u>+25</u>	24%
Performing Routine procedures	<u>+30</u>	28,67%
Performing Complex Procedures	<u>+30</u>	32%
Problem Solving	<u>+15</u>	15,33%

From the above table,

- There is a reasonable balance amongst the weightings of the cognitive levels which are consistent with requirements suggested in the examination guidelines. levels.

## 1.3 Mark distribution for topics in Mathematics Paper 2

LO	Description	Suggested marks	P 2: Nov 2009
3	Coordinate Geometry	± 40	35
3	Transformations	± 25	26
3	Trigonometry	± 60	61
4	Data Handling	± 25	28
	<b>TOTAL</b>	<b>150</b>	<b>150</b>

From the above table,

- it is quite evident that the distribution of marks with respect to the suggested topics is consistent with the requirements suggested in the examination guidelines. Also there is adequate coverage of all topics and learning outcomes.

## 2. Language

- Home language learners should have had no problem understanding the language, but some questions would have been difficult for the rest of the learners to understand – particularly questions 2.3; 2.4; 5.7 and 11.1, which used some unfamiliar words e.g.: trend, bearing, etc.

## 3. Fairness

- The overall feeling is that the paper was fair.
- Some teachers feel that Q10 which involved proving the tan identity, and an application of it, was unfair.
- Many learners may not know the properties of quadrilaterals (kite) from Grade 10, and therefore may not be able to do Q5.7.

## 4. General comments

- The standard of the paper was much higher compared to 2008, but appropriate and relevant for the learners.
- There was an acceptable level of cognitive demand in the paper.
- Examination papers provide a reasonable opportunity for the weaker learners to score at least 30%.
- There were some questions (Q5.6 – 5.7, Q10.2, Q11.1.2 and Q12) that involved critical thinking, but the high achievers should have had no problem answering them.
- Learners had sufficient time to complete the paper in the given time.

## 5. Recommendations

- Mark allocation to specific questions must take into account the amount of time and thinking a question requires. For example, the marks allocated for Q4.2, Q5.2 and Q10.1 were too few.
- The question paper should contain more questions from grade 12 work.
- The assessment standards must be properly interrogated against each examination item, so that learners are not prejudiced in any way. For example, in Q12.
- There should be more exemplars provided in order to illustrate all the different types of questions that could be asked.

## 6. Analysis of Paper 2 question – by - question

### Question 1 (8 marks)

This question relates to grade 11 work.

This question was reasonably fair, but learners would have difficulty answering Q1.4 where they had to *comment* on the spread of the rainfall. Learners without a good scientific calculator are disadvantaged by Q 1.5 where they must calculate the standard deviation for only 3 marks. With a calculator it is one step, but without it is a page of calculations and invariably they will make a mistake along the way.

It should be noted that since this is the first question in the paper, the set of data should be 11 rather than 12. If the data was 11 the five number summary would have worked out perfectly.

As a result of the selection of 12 it affects the calculation of the quartiles.

Some sources give the calculations as follows:-

$$Q_1 = 3^{\text{rd}} + \frac{1}{4}(4^{\text{th}} - 3^{\text{rd}})$$

$$Q_2 = 9^{\text{th}} + \frac{3}{4}(10^{\text{th}} - 9^{\text{th}})$$

$$\text{Others give } Q_1 = \frac{3^{\text{rd}} + 4^{\text{th}}}{2} \text{ and } Q_2 = \frac{9^{\text{rd}} + 10^{\text{th}}}{2}$$

**Question 2 (8 marks)**

This question relates to grade 11 work.

This question involved interpretation of data. However it required a lot of individual thinking and writing down reasons, describing the trends, etc – all of which most learners are unable to do. This is a language problem and not a mathematical one.

Furthermore, choice of a context for this question is problematic. In particular, for the data to have any validity then  $n(S) \geq 30$ .

For Q2.4: What reason can be given for this trend? Is it evolutionary? Better technology is used to coach swimmers. Better competition. How relevant is this question to rural learners? They may not have seen a swimming pool. An elitist sport in South Africa.

For Q 2.5: Any answer must be accepted

For Q2.6: Each learner's answer must be accepted.

**Question 3 (5 marks)**

This question relates to grade 12 work.

This question was asked the opposite way to usual, which will probably floor some of the learners.

They had to draw up a frequency table from the given ogive (cumulative frequency graph), and many will not put in an interval in the first column.

Furthermore Q3.3 is time consuming for 3 marks.

**Question 4 (13 marks)**

This question relates to grade 12 work.

This was a standard analytical geometry question.

In Q4.4., the midpoint of BC is dependent on 2 values. Whatever values learners get for 't' and 'p' must be accepted for the midpoint.

4.5 This question is also affected. Since these are independent questions learners must get full marks.

It would be advisable to say: Show that  $t = ?$  and  $p = ?$

This type of questioning does not prejudice learners. If there are calculation errors learners would be able to correct these errors immediately

**Question 5 (22 marks)**

This question relates to grade to both grades 11& 12 work.

Q5.1 – 5.6 were straight forward, but Q5.7 was confusing. Possibly if the second circle had been drawn on the diagram it would have been clearer. Also if learners do not know the properties of a kite, they will be prejudiced particularly since Euclidean Geometry is optional.

**Question 6 (15 marks)**

This question relates to both grades 11& 12 work.

Q 6.1 tested transformation geometry. Some teachers complained about Q6.1.4 which needed comments on the rigidity of the transformation, but rigidity is a concept stated in the NCS Assessment Standards, but has not been examined before.

Q6.2 was also criticized by teachers as it required 3 successive transformations and they felt they should have been separate. However this is acceptable, but again has not been asked previously in this way.

Examiners should note that an error in the first bullet will definitely lead to subsequent errors.

Hence, error carried forward marking must be applied.

**Question 7 (11 marks)**

This question relates to grade 12 work.

This was the usual question on rotation about a point through any angle, but there were complaints because it used letters (p & q) instead of numbers this time. However if learners had been taught the theory and had understood it they should have been able to adapt.

Q7.1: What does T have to do with this question?

Q7.3 Very difficult question. A previous HG type question.

**Question 8 (8 marks)**

This question relates to grade to both grades 11& 12 work.

A straight forward trigonometry question on trig ratios.

**Question 9 (21 marks)**

This question relates to grade 11 work.

This question was on reduction formulae and finding a general solution of an equation. There should be no problem for learners provided they know the basics of trigonometry.

**Question 10 (7 marks)**

This question relates to grade 12 work.

Many teachers are up in arms about this question, as it involves an identity that is no longer in the curriculum. But the question asked them to “prove the identity” using the expansions they know. Again the more capable learners should not have had a problem, but the weaker ones would not have succeeded.

There is a feeling that the question is unfair and that might compromise the achievement of learners.

**Question 11 (13 marks)**

There has been a lot of discussion around this question, that dealt with bearings (taught in Grade 10), and are 2-D. In all previous papers the question has dealt with a 3-D diagram, and hence many teachers did not prepare learners for this.

However, the entire question is previous HG work.

**Question 12 (12 marks)**

$$g(x) = 2 \cos(x - 30^\circ)$$

This is not in the curriculum- not an assessment standard.

This will affect the achievement of learners (12 marks)!

Furthermore, the drawing of the trig graph counted too few marks (only 2). However the readings (12.2) required manipulation first, and 12.4 required the learners to apply their knowledge of calculus here. Hence, this question is more for the capable learners!

**7. General conclusion:**

This was a reasonably fair paper that catered for all the different learners. Unfortunately the easy paper in 2008 misled the teachers and they were expecting a similar standard this year. There should be more exemplars provided in order to illustrate all the different types of questions that could be asked.

## APPENDIX C

### AMESA (Western Cape) Report: 2009 SC Mathematics Paper 1

#### Presentation

- Diagrams:** No particular issue. Q6 and Q8 could be smaller  
Graphs: When domain is restricted, dots must indicate endpoints. Is the range being asked for the sketched graph or the function?
- Layout:** Fine

**Overall structure:** As expected.

#### Compliance with levels of thinking

Levels of thinking	<i>Suggested</i>	Nov 2009
I	$\pm 25\%$	4,7%
II	$\pm 30\%$	47,7%
III	$\pm 30\%$	31,3%
IV	$\pm 15\%$	17,3%

#### Compliance with content

	TOPICS	<i>Suggested</i>	Nov 2009
1	Patterns & Sequences (LO 1)	30	34
2	Annuities & Finance (LO 1)	15	16
3	Functions & Graphs (LO 2)	35	31
4	Algebraic manipulation, Equations (LO 2)	20	22
5	Calculus	35	34
6	Linear Programming (LO 2)	15	13

#### General

As a body of educators we:

1. Welcomed the higher standard of the paper but felt that the lack of guidance from current subject advisors re what level to expect was poor.
2. Thought that the jump from last year to this was rather large.
3. Agreed that the order of the paper was counter-productive. There was not enough scaffolding within each question for weaker learners.
4. Agreed that the breakdown of the paper into levels becomes meaningless if learners become rattled by difficult questions raised early in the exam, thus not getting to the easier end ones
5. Thought that there was not enough basic stuff. The more difficult questions tested more advanced mathematics, rather than higher order levels of thinking or reasoning.

## Gr. 12 '09 Paper 1: Question by Question Analysis

Q. no.	Procedure	Allocation of marks to levels of thinking				Marks	Topic	Comments
		I	II	III	IV			

### Q1: Equations; Inequality; Exponents & Surds [22]

1.1.1	quadratic equation	3				3	4	1.3 and 1.4 Is the factorising of Surd expressions in the AS's Last 2 questions both higher order. In trying to nullify the use of the calculator, the AS's are being ignored. 1.4 may be advanced work rather than higher order thinking.
1.1.2	quad. eqn. (formula)		4			4		
1.1.3	quadratic inequality		2	2		4		
1.2	simultaneous eqns.		5			5		
1.3	exponents & surds				3	3		
1.4	surds				3	3		

### Q2: Sequences: General terms; A.S./G.S. [10]

2.1.1	$T_n$ (linear)		3			3	1	If you are used to the algebraic way of working then it is straight forward, but it takes some thinking to start.
2.1.2	$T_n$ (exponential)			2		2		
2.2	A.S./G.S.				5	5		

### Q3: Sigma/A.S. [5]

3.1	1 <sup>st</sup> 3 terms ( $\Sigma$ )	1				1	1	T = 0 to 99 not clear, so will they notice?
3.2	$S_{100}$		4			4		They might lose 1 point for n = 99

### Q4: Quadratic Sequence [11]

4.1	$T_n$ of 1 <sup>st</sup> differences			3		3	1	Tricky sequence $\therefore$ all negative and decreases before increasing. Different first question as it was not expected. Next year level 2 It would be helpful for weak students to see a pattern that the first 3 or 4 sub questions in a question should be accessible to them, and the last few difficult, so that they can ensure their 40 – 50%.
4.2	1 <sup>st</sup> diff. betw. 2 terms				2	2		
4.3	$T_n$ of quad. sequence			4		4		
4.4	why $T_n < 0$				2	2		

### Q5: G.S. application / $T_n, S_n$ & $S_\infty$ [8]

5.1	pattern / G.S.		2			2	1	The tricky bit in this question is the year number. So they all might move to level 3 as it required a bit of thinking.
5.2	$150 + S_9$			3		3		
5.3	$150 + S_\infty$		3			3		

### Q6: Graphs: Parabola & Hyperbola [13]

6.1	Show ... (pts of int.)			6		6	3	6.1 Difficult question to start with. No confidence building. Different, leading to a cubic. Would substituting given coordinates into both equations be sufficient? 6.2 Nice question 6.4 Horrible – no elegance just grind. Too few marks?
6.2	axis of symmetry			2		2		
6.3	inverse of straight line	2				2		
6.4	alg (fn) manipulation			3		3		

### Q7: Graphs: Trigonometric [8]

7.1	range	1				1	3	By observation  At $-180^\circ$ makes it tricky
7.2	coords by symmetry			3		3		
7.3	Period		2			2		
7.4	$g(x) - f(x)$ a maximum		2			2		



Q. no.	Procedure	Allocation of marks to levels of thinking				Marks	Topic	Comments
		I	II	III	IV			

**Q8: Log graph [10]**

8.1	domain	1				1	3	Again an unusual start and so the whole question moves up a level  Learners did not have the inverse graph in front of them , which made this question hard Or level 4? Can you use the graph? But they must first know that (-3;8) lies on the graph.
8.2	inverse function			1		1		
8.3	equation of asymptote		1			1		
8.4.1	explain - reflect					1		
8.4.2	reflect, translate		1		3	3		
8.5	log ineq. (use graph)				3	3		

**Q9: Financial Maths [16]**

9.1	n? (reducing balance)		4			4	2	Financial Maths wordy and inaccessible in 2 <sup>nd</sup> and 3 <sup>rd</sup> language speakers  9.1 Was the answer supposed to be in whole years? 9.2.3 A NEW story not related to earlier parts  This is the basic question and the opening statement does not apply.
9.2.1	F <sub>v</sub> (compound incr.)		3			3		
9.2.2	annuity							
(a)	P <sub>v</sub> - find x			3		3		
(b)	Total of payments			1		1		
9.2.3	P <sub>v</sub> ; x; total payments		4			4		
9.2.4	difference	1				1		

**Q10: Calculus – derivatives [7]**

10.1	1 <sup>st</sup> principles		5			5	5	Every single question had negatives in. Far too much emphasis on negatives.
10.2	derive by rules		2			2		

**Q11: Calculus – sketch [17]**

11.1	find roots		3	2		5	5	Needed factor theorem to start
11.2	find turning points		5			5		
11.3	sketch		3			3		
11.4	x-coord. pt of infl.		2			2		
11.5	t.pts of h (translated)		2			2		

**Q12: Calculus – application [10]**

12.1	find height		2			2	5	
12.2	(inst) rate of change			3		3		
12.3	interpret			2		2		
12.4	t for min. derivative				3	3		

**Q13: Linear Programming [13]**

13.1	constraints			7		7	6	All fine. Reading constraints from the graphs is easier than setting up constraints from words  13.4 was hard and very HG!
13.2	profit expression		2			2		
13.3	no. for max. profit					2		
13.4	gradient (for given P)		2		2	2		
<b>Totals:</b>		<b>7</b>	<b>70</b>	<b>47</b>	<b>26</b>			

**More comments:**

Paper was tricky and the standard was unexpected.

Not enough bottom end marks.

Top end much better than last year.

Majority of learners are 2<sup>nd</sup> and 3<sup>rd</sup> language learners. 38% of the paper is problem solving. Was Question 2.1 really necessary? Could questions not be asked at a more simple level?

AP and GP Formulae on the formula sheet are very confusing. Go back to not having sigma notation.

## APPENDIX D

### AMESA (Western Cape) Report: 2009 SC Mathematics Paper 2

#### Presentation

**Diagrams:** Large and uncluttered

**Layout:** Good. Each question was on a separate page.

#### Overall structure

- Starting with data handling was something new and a different format to exemplars. Whilst a good idea as it is an easy section, this should have been announced beforehand.
- Some learners might have wasted valuable time on an easy section.
- Trigonometry felt like the old Higher Grade.

**Compliance levels were agreed upon by the group present at the meeting**

#### Compliance with levels of thinking

Levels of thinking	<i>Suggested</i>	Nov 2009
I	$\pm 25\%$	20%
II	$\pm 30\%$	37%
III	$\pm 30\%$	22%
IV	$\pm 15\%$	21%

#### Compliance with content

	TOPICS	<i>Suggested</i>	Nov 2009
1	Coordinate Geometry (LO 3)	40	35
2	Transformations (LO 3)	25	26
3	Trigonometry (LO 3)	60	61
4	Data Handling (LO 4)	25	28

#### General

- Paper 2 was also of a higher standard compared to 2008 and we were not warned about this.
- At least the harder questions came near the end.
- Request for the formula sheet to include the rotation of an angle formulae as the IEB has on their sheet.
- Request to have questions graded so that weaker learners know they will not get past question d) for example but that they should get a – c correct
- See further comments below especially comments on unfair questions 5.3 ; 5.7 and 10

Q. no.	Procedure	Allocation of marks to levels of thinking				Marks	Topic	Comments
		I	II	III	IV			

**DATA HANDLING: [28]**

**Q1: Mean, Box and Whisker and Standard Deviation [15]**

1.1	mean	2				2	4	Given the number line was a huge help made question easy  How long must comment be? Is skewness P2 or P3 mark allocation is fair if you use a calc. - if not????
1.2	5 no. summary	5				5		
1.3	b & w diagram	3				3		
1.4	comment on b & w		2			2		
1.5	standard deviation		3			3		

**Q2: Scatterplot & Line of best fit [8]**

2.1	name function	1				1	4	Both linear and exponential functions must be acceptable. Is it mathematically correct to say line of best fit, if it is a curve?
2.2	line of best fit	2				2		
2.3	trend		1			1		
2.4	reason	1				1		
2.5	comment		2			2		
2.6	predict	1				1		

**Q3: Cumulative frequency graph/Ogive [5]**

3.1	no. of students	1				1	4	converse of what students are used to - not difficult - just different
3.2	top 25%		1			1		
3.3	construct table			3		3		

**COORDINATE GEOMETRY: [35]**

**Q4: Formulae and Lines [13]**

4.1	gradient of line		2			2	1	The whole of question 4 was essentially and easy question but much depended on getting the two unknowns t and p and on realising that the 45 deg meant a gradient of 1
4.2	gradient, find t		2			2		
4.3	distance formula		4			4		
4.4	midpoint	2				2		
4.5	equation of line		3			3		

**Q5: Formulae, Lines, Circles, Angles, Quadrilaterals [22]**

5.1	midpoint	2				2	1	5.3 was an UNFAIR questions. Would the learners even know what to look for having done so little geometry? They might say that the diameter is parallel to the line.  5.5 tested the same concept as 5.3. Must the proof be analytical? not specified)What about angle in semi circle for P3 learners? Finding angle is only easy if they got lengths in 5.4 to be equal 5.7 was also an UNFAIR question . When last were learners expected to draw such a diagram on a given diagram , especially when their knowledge of inscribed circles and tangents to inscribed circles and radius perpendicular to tangents is so limited Where were the routine questions on circles?
5.2	show point on line	1				1		
5.3	rel'ship line & circle				4	5		
5.4	lengths		4			4		
5.5	prove right angle		3			3		
5.6	find $\theta$	1				1		
5.7	find radius of circle				6	6		

**TRANSFORMATIONS: [26]**

**Q6: Enlargement and Area; reflection; rotation; translation [15]**

6.1.1	area of $\Delta$		2			2	2	Does the general rule mean algebraic ( x ; y ) ..... This was not clear "rigidity". Although this is in the SAG document, how many teachers and learners understand the terminology? 6.2 needs scaffolding. 6 marks unfair for 1 final answer .Learners could get 0 if no steps shown
6.1.2	give rule	2				2		
6.1.3	draw enlargement	3				3		
6.1.4	rigidity	2				2		
6.2	rule (seq. of transf.)			6		6		

**Q7: Rotation [11]**

7.1	formula for image		2			2	2	7.1 If learners do not know the formula they will get 0. Previous exemplar questions did not encourage the use of the formula. IEB
7.2	coordinates of image			2		2		

Q. no.	Procedure	Allocation of marks to levels of thinking				Marks	Topic	Comments
7.3	find p and q				7	7		formula sheet includes this formula. It must be added to the NSC one. 7.3. This whole question is backward, especially starting with A' Simultaneous equations with surds and negative numbers is very difficult.

**TRIGONOMETRY: [61]**

**Q8: Sketch & Calculation; identities & formulae [8]**

8.1	sketch, find ratio		3			3		
8.2	identity	2				2	3	
8.3	double angle		3			3		

**Q9: Identities; Special Angles; General Solution [21]**

9.1	simplify/Identities		7			7		9.2 How will we know that learners did not use the calculator Procedure - when to use and when not 1) Write all angles as acute 2) co-ratios - have to make angles the same before cancelling 3) Choice between $1/\sqrt{2}$ and $\sqrt{2}/2$ or $1/\sqrt{3}$ and $\sqrt{3}/3$ - will both be accepted?
9.2	prove/special $\Rightarrow$ S			7		7	3	
9.3	general solution		7			7		

**Q10: Compound Angles & proof [7]**

10.1	prove formula				3	3		10.1 UNFAIR question. This is something out of an old HG test book. SAG document does not require the proof of $\tan(A+B)$ and whilst it can be proved from the RHS for 3 marks it is extremely cumbersome. 10.2 – also unfair old HG question . If candidate do not realize that $C = 180 - (A+B)$ they have no chance of getting this question.
10.2	prove identity				4	4	3	

**Q11: Solution of  $\Delta^s$  – application & proof [13]**

11.1.1	bearing			6		6		11.1.1 should have been the easy mark numerical question instead it involved bearings. This may have been covered in Gr 9 but is not specified in the SAG document. It also tested a lot of problem solving: 1. Use sine rule 2. Use revolution 3. Use parallel lines prop (co-int angles) - done geom in gr 9 4. Complete answer (sum of two angles) 2 <sup>nd</sup> and 3 <sup>rd</sup> language learners will have struggled with question 11.2 – also an old HG type question. Cos form of cose rule not on sheet so this creates some difficulty
11.1.2	distance btw. ships				3	3	3	
11.2	proof/cos-rule				4	4		

**Q12: Trig graph [12]**

12.1	sketch graph			2		2		12.1 2 marks for drawing a trig graph with 2 transformations is stingy. Two transformations on one graph is not part of the SAG document. AS mentions either a shift of amplitude not both $y = \cos(x \pm p)$ $y = \cos x$ not $y = \cos(x+p)$ 12.2 Where exactly must points A and B be marked.? At the points of intersection or on the x-axis. 12.4 cross curricular – bringing in calculus .
12.2	points on graph			2		2	3	
12.3	x-coords of points	3				3		
12.4	x-coord of turning pt.			2		2		
12.5	x if $g(x) < 0$			3		3		

<b>Totals:</b>	<b>30</b>	<b>55</b>	<b>33</b>	<b>32</b>				
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**General Comments**

- Both papers rather bitty and disjoint.
- Paper 1 would have been easier if done backwards.
- Can paper be set so that more difficult questions are always at the end?
- Grade question with more difficult questions at the end.
- We were caught by surprise by the standard of this paper.
- Could we be informed about the standards before the papers written?

## **APPENDIX E**

### **AMESA (Composite) Report: 2009 SC Mathematical Literacy Paper 1**

In terms of AMESA's vision and goals, the purpose of this report is to provide effective feedback to the Department of Education on the following aspects regarding grade 12 examinations in mathematics:

- The cognitive demand of the examination papers with special reference to:
  - Content coverage and content relevance
  - Difficulty levels of questions.
- Compliance with Policy and Assessment and Exam Guidelines
- Language
- Fairness

In developing this report, written input from all provinces were considered to provide effective feedback in terms of the following format:

- Standard of paper
- Coverage of content, learning outcomes and assessment standard
- Language
- Length (time factor)
- Fairness
- Comparison to previous years
- Other comments

#### **1. Standard of paper**

- Fairly easy
- Learners could answer the paper with confidence
- 60% level 1 questions adhered

#### **2. Coverage of content, learning outcomes and assessment standards**

- Good – learners will do well

#### **3. Language**

- Language used was clear
- Terminology was within the grasp of learners

#### **4. Length (time factor)**

- Teachers stated that their learners finished the paper in 2 hours

#### **5. Fairness**

- All agreed that the paper was fair; some teachers said that they prepared their learners for a more higher level paper; the outcome was that they wrote a much easier paper

#### **6. Comparison to previous years**

- 2009 paper better than 2008 – instructions easy to follow
- Learning Outcome 3 – reduced in comparison
- Teachers appreciated the short simple context questions

#### **7. Other comments**

- Balanced paper
- It allowed learners to prepare for paper 2 with confidence
- Some context questions (Q3 & Q5) were repeated

## **APPENDIX F**

### **AMESA (Composite) Report: 2009 SC Mathematical Literacy Paper 2**

In terms of AMESA's vision and goals, the purpose of this report is to provide effective feedback to the Department of Education on the following aspects regarding grade 12 examinations in mathematics:

- The cognitive demand of the examination papers with special reference to:
  - Content coverage and content relevance
  - Difficulty levels of questions.
- Compliance with Policy and Assessment/Exam Guidelines
- Language
- Fairness

In developing this report, written input from all provinces were considered to provide effective feedback in terms of the following format:

- Standard of paper
- Coverage of content, learning outcomes and assessment standard
- Language
- Length (time factor)
- Fairness
- Comparison to previous years
- Other comments

#### **1. Standard of paper**

- Fair and in keeping with the Subject Assessment Guidelines
- There is no middle ground in some questions in terms of scoring marks (0 or close to the maximum)

#### **2. Syllabus coverage**

- Questions were reasonably spread over the entire syllabus
- Perception that Learning Outcome 4 had the least content apart from a few questions on probability

#### **3. Language**

- On the whole Mathematical Literacy P2 is still too embedded in extensive reading
- Level of language used was fair

#### **4. Length (time factor)**

- Learners should have been able to complete the paper quite comfortably, within the 3 hours

#### **5. Fairness**

- The questions were structured according to the level of difficulty
- Questions assessed all levels of thinking

#### **6. Comparison to previous years**

- There were no distinct differences between the 2009 and 2008 paper
- Learners should have been quite prepared for the paper

#### **7. Other comments**

- There was integration with economics/financial sector throughout
- There was some awkward or difficult questions at the beginning and it became easier towards the end.