



AMESA Office
P.O Box 54
WITS
2050

Tel: 011 717 3461
Fax: 011 717 3459
Cell: 083 9600 626
president@amesa.org.za

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Mr Bobby Soobrayan
Director General
Department of Basic Education
222 Struben Street
PRETORIA

Re: AMESA Report of the Maths & Maths Literacy Examination Papers

On behalf of the National Council of the Association for Mathematics Education of South Africa (AMESA), I would like to commend the Department of Basic Education for the wonderful support afforded the Grade 12 learners and their teachers in the 2011 academic year.

I would also like to make a formal submission of the AMESA Report of the Mathematics and Mathematics Literacy Examination Papers 1 & 2 that were written by the Grade 12 learners on the October and 31 November 2011 respectively.

The purpose of the report is to provide constructive feedback to the Department of Education in the spirit of promoting Mathematics education and enhancing the quality of the teaching and learning of Mathematics in South Africa. The report will cover specific comments on each paper focusing on the following aspects:

- A. Overall Review
 - 1. Technical Aspects (typing; diagrams; etc)
 - 2. Language used and compliance with the cognitive levels of thinking
 - 3. Curriculum coverage
 - 4. Comparison with 2010 papers
 - 5. Overall Observations
- B. Question by Question Analysis

It is our hope that the report, especially the question by question analyses will be useful to the Examiners, Markers and Moderators in our attempt to promote the high standard of Mathematics education in our country.

Many thanks

Elsbeth Mmatladi Khembo
AMESA National President

REPORT OF THE AMESA CURRICULUM COMMITTEE ON THE 2011 SENIOR CERTIFICATE MATHEMATICS AND MATHEMATICAL LITERACY EXAMINATION PAPERS

Introduction

The 2011 National Examinations for Mathematics and Mathematical Literacy were written on 28 October and 31 November 2011. AMESA members from various parts of the country were asked to review the papers and give constructive comment on the papers. This report is based on input received from members in AMESA regions and appears as a consolidated report.

MATHEMATICS PAPER 1 ANALYSIS

A. Overall Review

1. Technical Aspects (typing; diagrams; etc)

The technical aspects of the paper are in keeping with the high standard set by the Department of Basic Education. All diagrams, graphs, etc were clear and readable

2. Language used

There was good use of language in the paper. The terminology used should have been familiar to most learners. The following issues/points were raised:

- The use of the word “an” (as opposed to “the”) in questions 6.2 ; 6.3 ; 6.4 ; 6.5 ; and 9.2 was confusing. Q 1.2.2 should have read “hence, **or otherwise**” – unfair question as failure to get solution for fairly tough Q 1.2.1 precludes the pupil from getting this solution as this could be done without 1.2.1.
- Question 3.3 use the word “infinite” sequence which could be confusing
- The wording in 7.3 may have been a bit ambiguous/confusing to the learners
- The language used in question 12, usually a problem area, was on the mark

3. Syllabus coverage

| Code | Content/Topic | Suggested | Actual |
|------|---|-----------|-----------|
| 1 | Patterns & Sequences (LO1) | 30 | 29 |
| 2 | Annuities & Finance (LO1) | 15 | 16 |
| 3 | Functions & Graphs (LO2) | 35 | 33 |
| 4 | Algebraic manipulation; equations (LO2) | 20 | 19 |
| 5 | Calculus (LO2) | 35 | 36 |
| 6 | Linear Programming (LO2) | 15 | 17 |
| | TOTAL | 150 | 150 |

4. Standard of Paper & Compliance with cognitive levels of thinking

4.1 Standard of paper

The paper was of a very high standard. It was definitely higher than the 2010 paper. It adhered to the weighting of various topics weighting and cognitive levels were in keeping with the subject assessments guidelines. One would not

call any question as being unfair. However, the following comments/issues are noted:

- There were “catches” in every question! , i.e. 1.2.2 ; 2.3 ; 3.3 ; 4 ; 5.2 ; 6.6 ; 7.3 ; 9 ; 10 ; 11
- The latter questions demanded a more of mathematical understanding but were manageable.
- The simultaneous equation question, usually a standard question, was complicated.
- The proof asked in 2.3 took some learners by surprise as they were not used to doing “proof” in the new curriculum.

4.2 Compliance with levels of thinking

| Levels of thinking | Suggested | November 2011 |
|------------------------|-----------|---------------|
| 1 – Knowledge | ± 25% | 25% |
| 2 - Routine procedures | ± 30% | 29% |
| 3 - Complex procedures | ± 30% | 31% |
| 4 - Solving problems | ± 15% | 15% |

1. Comparison with 2010 paper

Although the paper was similar in style to the 2010 paper, the change in approach in many questions where higher order thinking was demanded, made the paper slightly more difficult than the 2010 paper.

2. Overall Observation

The feedback from those who wrote the paper was mixed with some claiming the paper the paper to be easy while others saying it was difficult. Some questions were “repeated” such as the simultaneous equations to be set up in questions 1.2.2; 4.1 and 9.1 and those who were not exposed to these types of questions would have found this difficult and could lose as much as 17 marks.

Nevertheless, it would reasonable to say that **this was a fair paper, in keeping with the prescriptions of the curriculum and catering for various ability levels.**

B. Question by Question Analysis:

| Question 1 | | | | | | [19] | Topic Code | Comment |
|------------|--|--------|---|---|---|-------|------------|--|
| Quest. | Content | Levels | | | | Marks | | |
| | Algebraic manipulations and equations | 1 | 2 | 3 | 4 | | | |
| 1.1.1 | Quadratic equation by factorising | ✓ | | | | 3 | 4 | Straightforward; fair question |
| 1.1.2 | Quadratic equation by Formula | ✓ | | | | 4 | | Straightforward; fair question |
| 1.1.3 | Quadratic inequality | | ✓ | | | 4 | | Straightforward; fair question |
| 1.2.1 | Quadratic with ratio | | | ✓ | | 3 | | Different way of asking this; what about the exclusion of $y = 0$. |
| 1.2.2 | Simultaneous equations | | ✓ | | | 5 | | If they simply use the two equations and solve simultaneously – how will |

| | | | | | | | | |
|-----|--|--|----------|--|----------|----------|---|--|
| 4.1 | Quadratic Patterns with simultaneous equation to find 2 nd diff | | | | ✓ | 5 | 1 | Cognitively demanding; involving the setting up of simultaneous equations. |
| 4.2 | Calculating first term | | ✓ | | | 2 | | Use pattern established to calculate first term |
| | TOTAL | | 2 | | 5 | 7 | | |

Question 5 [19]

| Quest. | Content | Levels | | | | Marks | Topic Code | Comment |
|--------|---------------------------------|----------|----------|----------|----------|-----------|------------|---|
| | | 1 | 2 | 3 | 4 | | | |
| | Hyperbola & Parabola | | | | | | | |
| 5.1.1 | Y int of hyperbola | ✓ | | | | 2 | 3 | Straightforward; fair question |
| 5.1.2 | X int of hyperbola | ✓ | | | | 3 | | Straightforward; fair question |
| 5.1.3 | Sketch hyperbola | | ✓ | | | 4 | | Sketching known graph |
| 5.1.4 | Inequality with graph | | | ✓ | | 2 | | Selecting appropriate region and writing it correctly |
| 5.1.5 | Average gradient | ✓ | | | | 4 | | Fractions make it difficult |
| 5.2 | Sketch Parabola abstract values | | | | ✓ | 4 | | “Only one solution” is incorrect terminology – should say equal roots. It is understandable that the examiner may not have wanted to cause confusion amongst candidates who may not know this terminology, but mathematical conventions should be adhered to; learners may be unfamiliar with this type of question |
| | TOTAL | 9 | 4 | 2 | 4 | 19 | | |

Question 6 [14]

| Quest. | Content | Levels | | | | Marks | Topic Code | Comment |
|--------|---|--------|---|---|---|-------|------------|--|
| | | 1 | 2 | 3 | 4 | | | |
| | Exp Graph & Parabola | | | | | | | |
| 6.1 | x & y intercepts of exponential graph | | ✓ | | | 4 | 3 | Write in coordinate form |
| 6.2 | Asymptote of exp. graph | ✓ | | | | 1 | | Straightforward; fair question |
| 6.3 | F(x) notation with exponents | | | ✓ | | 2 | | Substitution; new function |
| 6.4 | Inverse of exponential graph | | ✓ | | | 2 | | Marks lost if 6.3 not completed. |
| 6.5 | Reflection of exp graph | | | ✓ | | 1 | | Marks lost if 6.3 not completed. |
| 6.6 | Finding equation of parabola and applying sigma | | | | ✓ | 4 | | “Show all working” may be deceptive as the best solution is just seen, not worked. Interesting |

| | | | | | | | | |
|--|----------------------|----------|----------|----------|----------|-----------|--|-----------|
| | notation to equation | | | | | | | question. |
| | TOTAL | 1 | 6 | 3 | 4 | 14 | | |

Question 7 [16]

| Quest. | Content | Levels | | | | Marks | Topic Code | Comment |
|--------|--------------------------|----------|----------|----------|---|-----------|------------|--|
| | | 1 | 2 | 3 | 4 | | | |
| | Finance | | | | | | | |
| 7.1 | Find n using logs | ✓ | | | | 4 | 2 | Interpret question then do a simple calculation |
| 7.2 | Apply SI and CI formulae | | | ✓ | | 6 | | Interpretation; select appropriate formula and then justify answer |
| 7.3 | Annuities | | ✓ | | | 6 | | Interpret given information then do appropriate calculation |
| | TOTAL | 4 | 6 | 6 | | 16 | | |

Question 8 [12]

| Quest. | Content | Levels | | | | Marks | Topic Code | Comment |
|--------|----------------------------|----------|----------|----------|---|-----------|------------|---|
| | | 1 | 2 | 3 | 4 | | | |
| | Calculus | | | | | | | |
| 8.1 | 1 st principles | ✓ | | | | 5 | 5 | Straight forward |
| 8.2.1 | Differentiation with rule | | ✓ | | | 3 | | Write in appropriate form the use rules |
| 8.2.2 | Differentiation | | | ✓ | | 4 | | Multiply out first |
| | TOTAL | 5 | 3 | 4 | | 12 | | |

Question 9 [14]

| Quest. | Content | Levels | | | | Marks | Topic Code | Comment |
|--------|--|----------|---|----------|---|-----------|------------|---|
| | | 1 | 2 | 3 | 4 | | | |
| | Calculus | | | | | | | |
| 9.1 | Calculations of unknowns from drawn graphs | | | ✓ | | 7 | 5 | Involved simultaneous equations for the 2 nd time in paper What if given values were substituted into $f(x)$ – how will this be marked? |
| 9.2 | Equation of tangent | | | ✓ | | 5 | | Using point-gradient to find equation |
| 9.3 | Point of inflection | ✓ | | | | 2 | | Straightforward application of 2 nd derivative |
| | TOTAL | 2 | | 7 | | 14 | | |

Question 10

| Quest. | Content | Levels | | | | Marks | Topic Code | Comment |
|--------|---|--------|---|----------|----------|----------|------------|--|
| | | 1 | 2 | 3 | 4 | | | |
| | Calculus | | | | | | | |
| 10.1 | Given $f(x)$ Decreasing function | | | ✓ | | 1 | 5 | Straight forward analysis of drawn graph |
| 10.2 | Find min value from derivative function | | | | ✓ | 3 | | Abstract but has been examined before |
| | TOTAL | | | 1 | 3 | 4 | | |

Question 11 [6]

| Quest. | Content | Levels | | | | Marks | Topic | Comment |
|--------|---------|--------|--|--|--|-------|-------|---------|
|--------|---------|--------|--|--|--|-------|-------|---------|

| | Calculus Application | 1 | 2 | 3 | 4 | | Code | |
|-------------------------|--|---------------|-----------|-----------|-----------|--------------|-------------------|---|
| 11.1 | Finding initial volume, that is, $v(0)$ | ✓ | | | | 1 | 5 | Language is difficult for non-mother-tongue speakers. |
| 11.2 | Two different expressions for rate of change | | | | ✓ | 3 | | Needs careful reading |
| 11.3 | Value of k (rate) | | | ✓ | | 2 | | Requires equating of 2 expressions in 11.2; marks lost if 11.2 is wrong or not done |
| | TOTAL | 1 | | 2 | 3 | 6 | | |
| Question 12 [17] | | | | | | | | |
| Quest. | Content | Levels | | | | Marks | Topic Code | Comment |
| | Linear Prog | 1 | 2 | 3 | 4 | | | |
| 12.1 | Setting up constraints | | | ✓ | | 6 | 6 | Interpret information; write constraints |
| 12.2 | Drawing graphs | | ✓ | | | 4 | | Marks lost if 12.1 is incorrect |
| 12.3 | Transport cost | ✓ | | | | 1 | | Creating an expression in terms of x and y |
| 12.4.1 | Values of x and y so cost is a minimum | | | ✓ | | 3 | | Must use feasible region (from graphs) |
| 12.4.2 | Calculate minimum cost | ✓ | | | | 2 | | Interpret expression in 12.4.1 |
| 12.5 | Change of one constraint | | | | ✓ | 1 | | New scenario but also asking for minimum cost |
| | TOTAL | 3 | 4 | 9 | 1 | 17 | | |
| Overall Total | | Levels | | | | Marks | | |
| | | 1 | 2 | 3 | 4 | | | |
| All questions | | 38 | 44 | 46 | 22 | 150 | | |

MATHEMATICS Paper 2 ANALYSIS

A. Overall Review

1. Technical Aspects (typing; diagrams; etc)

All technical aspects of the paper are in keeping with the high standards set by the Department of Basic Education.

2. Language used

The language used in the paper would be understandable to most learners. It was precise and to the point. Learners should be familiar with the terms/words/concepts used in the paper as they would have come across these in their lessons.

3. Curriculum coverage

All work was covered as per work schedule/pace setters.

| Code | Content/Topic | Suggested | Actual |
|------|-------------------------------|------------|------------|
| 1 | Coordinate Geometry (LO3) | 40 | 38 |
| 2 | Transformation Geometry (LO3) | 25 | 20 |
| 3 | Trigonometry (LO3) | 60 | 62 |
| 4 | Data Handling (LO4) | 25 | 30 |
| | | | |
| | | | |
| | TOTAL | 150 | 150 |

4. Standard of Paper & Compliance with Cognitive levels of thinking

4.1 Standard of paper

The paper was of a reasonable standard. It was well balanced and catered for a variety of ability levels. Insight and higher order thinking was needed in questions 5.7, 10.4 and 12.3.2. A number of questions required multi-step procedures.

4.2 Compliance with levels of thinking

| Levels of thinking | Suggested | November 2011 |
|------------------------|------------|---------------|
| 1 - Knowledge | $\pm 25\%$ | 27% |
| 2 - Routine procedures | $\pm 30\%$ | 30% |
| 3 - Complex procedures | $\pm 30\%$ | 27% |
| 4 - Solving problems | $\pm 15\%$ | 16% |

5. Comparison with 2010 paper

Although there were various views on the comparison to the 2010 paper it would appear to be on a par with the 2010 paper and, perhaps, marginally easier than that paper.

6. Overall Observations

It would appear that the paper, although difficult in some areas, had enough marks at level 1 and level 2 (57%) for learners to pass. It would be, thus, reasonable to say that **this was a fair paper, in keeping with the prescriptions of the curriculum and catering for various ability levels.**

B. Question by Question analysis:

| Question 1 Data Handling (Median, IQR/box & whisker) [9] | | | | | | | | |
|--|---|----------|----------|----------|----------|----------|------------|---|
| Quest. | Content | Levels | | | | Marks | Topic Code | Comment |
| | | 1 | 2 | 3 | 4 | | | |
| 1.1 | Median | ✓ | | | | 1 | 4 | Straightforward |
| 1.2 | IQR | | ✓ | | | 3 | | Need to find Q1 and Q3 and then subtract |
| 1.3 | Box and whisker | | ✓ | | | 3 | | Based on a number of calculations |
| 1.4 | Comment | | | | ✓ | 2 | | Allows for guessing – should rather have asked which golfing scores lie outside one std deviation |
| TOTAL | | 1 | 6 | - | 2 | 9 | | |
| Question 2 Data Handling (STD Deviation and mean) [6] | | | | | | | | |
| Quest. | Content | Levels | | | | Marks | Topic Code | Comment |
| | | 1 | 2 | 3 | 4 | | | |
| 2.1 | Mean | ✓ | | | | 2 | 4 | Straightforward |
| 2.2 | Standard deviation | | ✓ | | | 2 | | Use of calculator |
| 2.3 | Apply std. deviation | | | ✓ | | 2 | | Possibly too open-ended. |
| | | | | | | | | |
| TOTAL | | 2 | 2 | 2 | | 6 | | |
| Question 3 Data Handling (Scatter-plot) [6] | | | | | | | | |
| Quest. | Content | Levels | | | | Marks | Topic Code | Comment |
| | | 1 | 2 | 3 | 4 | | | |
| 3.1 | Scatter-plot | ✓ | | | | 1 | 4 | Question on scatter plot |
| 3.2 | Relationship between 2 variables | ✓ | | | | 2 | | Determining relationship |
| 3.3 | Conclusion based on relationship | | ✓ | | | 1 | | Reaching a conclusion |
| 3.4 | Using a value and scatter plot to predict | | | | ✓ | 2 | | Making a prediction |
| TOTAL | | 3 | 1 | | 2 | 6 | | |
| Question 4 Data Handling (Cumulative Frequency and Ogive) [9] | | | | | | | | |
| Quest. | Content | Levels | | | | Marks | Topic Code | Comment |
| | | 1 | 2 | 3 | 4 | | | |
| 4.1 | Cum. frequency table | ✓ | | | | 3 | 4 | T and t in paper was problematic |
| 4.2 | Ogive | ✓ | | | | 4 | | Table should have been given on diagram sheet |
| 4.3 | Estimate from ogive | | ✓ | | | 2 | | |
| | | | | | | | | |
| TOTAL | | 7 | 2 | | | 9 | | |
| Question 5 Analytical Geometry [22] | | | | | | | | |
| Quest. | Content | Levels | | | | Marks | Topic Code | Comment |
| | | 1 | 2 | 3 | 4 | | | |
| 5.1 | Product of gradients | ✓ | | | | 4 | 1 | Pythagoras could also be used |

| | | | | | | | | |
|-----|---------------------------|-----------|----------|----------|----------|-----------|---|--|
| 5.2 | Equation of straight line | ✓2 | ✓2 | | | 4 | 2 | |
| 5.3 | Calculate coordinates | ✓2 | ✓2 | | | 4 | | Should only be 2 marks. Instruction should not be "calculate", but should be "determine" |
| 5.4 | Horizontal length | ✓ | | | | 2 | | |
| 5.5 | Equation of circle | | ✓ | | | 3 | | |
| 5.6 | Show point on circle | | ✓1 | ✓1 | | 2 | | Will a geometric argument (angle in semi-circle) be acceptable? |
| 5.7 | Translation | | | | ✓ | 3 | | Sum concept seems a little contrived. Why is it stipulated that k and l are numbers |
| | TOTAL | 10 | 8 | 1 | 3 | 22 | | |

Question 6 Analytical Geometry [19]

| Quest. | Content | Levels | | | | Marks | Topic Code | Comment |
|--------|------------------------------|----------|----------|----------|----------|-----------|------------|--|
| | | 1 | 2 | 3 | 4 | | | |
| 6.1 | Vertical length | ✓ | | | | 2 | 1 | Many may have missed the $CB = 5$. Statement would have helped to have it on the diagram. Co-ordinates for B should also have been on the diagram |
| 6.2 | Theorem of Pythagoras | | ✓ | | | 3 | | Note that radius is perpendicular tangent |
| 6.3 | Definition of $\tan \theta$ | | ✓ | | | 1 | | |
| 6.4 | Gradient of radius | | ✓ | | | 2 | | |
| 6.5 | Point of intersection | | | ✓ | | 6 | | |
| 6.6 | Ratio of areas of Δ^s | | | ✓2 | ✓3 | 5 | | |
| | TOTAL | 2 | 6 | 8 | 3 | 19 | | |

Question 7 Transformation Geometry [8]

| Quest. | Content | Levels | | | | Marks | Topic Code | Comment |
|--------|---------------------------------------|----------|----------|----------|---|----------|------------|---|
| | | 1 | 2 | 3 | 4 | | | |
| 7.1 | Translation and rotation) | | | ✓ | | 4 | 2 | |
| 7.2 | Reflect circle about the line $y = x$ | ✓2 | ✓2 | | | 4 | | Seems to be pointless to change the form of the equation of the circle. |
| | TOTAL | 2 | 2 | 4 | | 8 | | |

Question 8 Transformation Geometry [9]

| Quest. | Content | Levels | | | | Marks | Topic Code | Comment |
|--------|----------------------|--------|---|---|---|-------|------------|--|
| | | 1 | 2 | 3 | 4 | | | |
| 8.1 | Describe rotation | | | | ✓ | 2 | 2 | Problem for those with poor language skills |
| 8.2 | Coordinates of image | | ✓ | | | 2 | | |
| 8.3 | Coordinates of image | | | ✓ | | 2 | | 8.3 and 8.4 are new scenarios and not linked to the transformation used in 8.1 and 8.2; the question should have better phrasing |
| 8.4 | product of areas | | ✓ | | | 3 | | 6.6 and 8.4 Similar feel to both questions; a contrived |