Research and Information Services

MONITORING STANDARDS REPORT

SCOTTISH QUALIFICATIONS AUTHORITY

Comparison of Mathematics Intermediate 1 2006 and 2002

Summary of findings

The panel concludes the overall level of demand for Mathematics Intermediate 1 has remained the same for 2006, compared to 2002.

Syllabus

There have been no content changes in the syllabus for 2006, compared to 2002.

Assessment instruments

The panel concludes the syllabus has been assessed in comparable terms over the two years, with the examination papers offering a similar breadth and depth of coverage given the necessary selection that takes place in making up such an instrument. There are no significant changes in the structure of the examination papers or the style of questions included.

Marking instructions

Marking instructions were modified between 2002 and 2006, placing greater clarity over what constitutes an acceptable response in some algebraic tasks. In practice, this change would require candidates to show a valid method in order to receive full credit.

Scripts

The panel made a comparison of scripts representative of different awards. From the 2002 cohort there were nine scripts — six at the A/B boundary and three at Grade 6 on the C/D boundary. In the 2006 cohort, a similar distribution of scripts was made available with the addition of three scripts at Grade 7 on the C/D boundary, making a total of 12 scripts in the sample from that year. The panel concludes that the grades awarded in each of those boundary samples were comparable, and that the level of performance has been consistent over time.

1 Introduction

There have been significant changes in the population of candidates during this period, with a significant increase in entries as well as a change in the profile of presentations. These changes have been due to the relaxation of Age and Stage regulations, and also the policy shift in centres, with some movement away from Standard Grade presentations towards a fuller uptake of the other National Qualifications, including Mathematics Int 1, (see Appendix 1).

The breakdown by stage was not applicable in 2002 as the Age and Stage regulations were still in operation, but the data in the following years shows the trend for more candidates from the lower stages to be presented for Mathematics Intermediate 1 in 2006. Such a shift in the composition of the cohort brings a broader range of ability into the examination, albeit of a less mature nature that may not have the breadth of experience and contexts the course was originally designed to accommodate. The change in the profile of entries has resulted in an upward shift in the grades achieved by candidates in 2006 compared to 2002, with more than twice as many Grade A awards in 2006 as witnessed in the data presented in Appendix 2.

2 Level of demand of arrangements/syllabus

There have been no substantive changes in the arrangements or syllabus over the period. Course numbers, titles and entry levels were changed, as indicated in the opening section of the Arrangements for 2006 (Fourth edition – published March 2002), but no changes in unit specification or content.

2.1 Breadth

The breadth of the syllabus in 2006 was no more demanding than in 2002.

There were no additions in terms of mathematical content in the latest edition of the arrangements for 2006 (Fourth Edition, March 2002).

There has been no change to the mathematical content from 2002 to 2006.

There were no content changes or variation in suggested approaches between 2002 and 2006.

2.2 Depth

Mathematical content was no more demanding in depth in 2006 than in 2002

There was the same emphasis on integration of skills and content.

3 Level of demand of examination questions

The features of the course which affect the level of demand have not changed, but the panel considered the following to be relevant to the demands in the examination:

- Questions on A/B content as referenced in the Arrangements.
- Questions deemed to be A/B because of the level of difficulty created through for example ‘complex contexts’ (Arrangements for 2006, published March 2002: Page17).

- Non-routine questions across all levels.

Distribution of marks on the papers being reviewed, taking the A/B level and non-routine opportunities into account (see Appendix 3). The proportion of A/B items in each year was the same, but in 2006 there was a greater weighting towards the non-routine situations in the A/B items. This may be an explanatory factor in the students' performances reported later.

The examination questions were categorised by the panel in terms of syllabus coverage and degree of difficulty (see Appendix 4). Difficulty was determined on the basis of a three-point scale, taking the syllabus item related to the assessment task and rating it as a *limited or easy task* within that content area (1); as *routine* for that content (2); as difficult or challenging within the content possibilities (3). It should be noted that A/B items can themselves be assessed in a readily accessible way, through a routine task or as a challenging item within the overall assessment, ie on the scale of 1 – 3.

The Content Reference List (Additional Questions Bank INT1) was utilised in detailing the coverage of the syllabus. This was added to, extending the coverage to include wider aspects of the course that are not currently detailed in terms of content, namely:

- Non-calculator numerical skills (coded as 1.1.0 – Calculation in Appendix 4)
- Problem Solving (coded as 3.5 in

- Appendix 4)

These components are described in detail under the section 'Details of the Instruments for External Assessment' of the Arrangements for 2006 (Fourth edition – published March 2002: p17-18)

In summary:

General approach in the assessment instruments

There was no change across the two years, with a comparable balance of questions across the breadth of the course as well as offering equivalent opportunities at A/B level and through non-routine items.

Coverage of the syllabus

Some gaps in coverage across the two years were identified, but any concerns have been discussed with and clarified by the Principal Assessor. In particular:

- The need to include A/B content meant that simple cases of 'composite shapes' or 'expressions in symbols' could not be included in either examination.
- Some content is covered within other contexts eg 'straight line work' embracing 'integers' through the calculation of values to plot coordinates in four quadrants when identifying points on a given line.
- A lack of clarity in the content reference list, eg 'Multiply Expressions' really means 'Remove brackets' – the examples given in the Arrangements all refer to bracketed expressions.
- Other content identified as 'missing' is covered in intervening years; it just so happened that the chosen papers (2002 and 2006) had gaps in content that would clearly be assessed on a rolling basis given all content cannot be assessed in every examination diet.

Structure of the total assessment task

The same structure was adopted in each year, with two Papers comprising a mixture of items primarily presented in a context. Paper 1 in each year seeks to assess non-calculator skills; Paper 2 permits use of a calculator. The structure of the total assessment task was comparable across the 2002 and 2006 presentations.

Demands of assessment tasks/questions

The overall demands were comparable across the two examinations. Inevitably there were slight differences in emphasis, with some topics being presented at a different level from one year to the next, eg in the questions assessing 'using formulae' (3.1.1) the 2002 paper (Q13 on body mass index) was judged to be more demanding then the comparable item in 2006 (Q9 on a Physics formula). It would be inappropriate to conclude the 2002 paper is

‘harder’ on the basis of individual items — indeed the detailed analysis shows that on six occasions the 2006 examination was more demanding on specific content while the 2002 examination was rated as being more demanding on four occasions. Overall, the conclusion is that the examinations offer equivalent demands across the two years.

There is detailed comment on the differences noted by the panel across the 2002 and 2006 assessment in Appendix 5.

4 Level of demand of examination marking

4.1 Different type of instructions

Instructions have generally been consistent across the years, reflecting the fact the examination team has been stable over that period. One significant change is under the Equations and Inequations unit, where the marking criteria have been modified so that only valid methods are given full credit. In 2002, a trial and improvement method was given partial credit, whereas in 2006, such a response is not credited with any marks. This change may well account for a shift in marks allocated within Unit 3 topics, particularly at the lower end of the distribution (Band 6/7) — something that was noted in the small sample of scripts provided for this exercise.

4.2 More or fewer examples

This was clearly dependent on the type of question, with some receiving a lot of detail and alternative responses. There was no change over the years in the number of examples for the type of question or syllabus content.

4.3 More or less detail

The instructions are clear and comprehensive in their coverage across the two years. Suitable exemplars are included for markers. Additionally, the marking instructions outline typical candidate responses to cover situations where an error has been made in an early part of the task to highlight where credit can be gained for subsequent working. There is very little reason for markers to deviate from the scheme or to incorrectly penalise candidates given the detailed breakdown provided in the Finalised Marking Instructions.

5 Grading of candidates’ performance

The panel was very satisfied with the measures taken to ensure scripts demonstrating comparable performance were graded in a similar way in 2006 and 2002. The resultant grade boundaries are very similar across the years, as shown in
Appendix 6, which provides cut off scores and corresponding percentages for the boundaries shared with the panel.

5.1 Grade A band 2 scripts

The three Grade A band 2 scripts from each cohort were scrutinised — giving due consideration to the overall performance, attainment with A/B and non-routine items, performance across the three component Units, and finally performance across the two papers — to comment on calculator/ non-calculator opportunities.

- The Grade A band 2 scripts were broadly comparable across the years.
- There were indications of A/B items being stronger in 2006 yet weaker on the non-routine tasks than their counterparts in 2002. The fact there was a greater proportion of non-routine items within the A/B items in 2006 may be a factor here. Alternatively, this difference is perhaps a reflection on candidates being very well prepared for the examination yet less confident on non-routine situations. This conjecture is obviously on the basis of the very small sample but perhaps flags up something worthy of researching further through a wider analysis of candidates' performance across different items.
- No difference in performance across the three units
- No difference across the Calculator/ Non-Calculator Papers.

5.2 Grade C band 6 scripts

The three Grade C band 6 scripts from each cohort were scrutinised, giving due consideration to the same aspects as outlined above. Unfortunately, the panel felt that two of the three candidates in the 2002 cohort may not be fully representative given their responses and success rates on what was believed to be a particularly challenging item. The 'Body mass index' question (2002, Q13) was completed with full marks by two of the candidates, the third gaining 1 mark out of the possible 5. This performance was not replicated by the rest of the sample, but it would have been particularly useful to have a sample of Grade C band 7 candidates to comment further on this observation — no candidate scripts for this level were included in the 2002 sample as these had not been included in the archive that year.

- With this proviso, the Grade C band 6 scripts were broadly comparable across the years.
- As with the Grade A candidates, there were signs that A/B items were possibly stronger in the 2006 cohort but with less of a difference being noted on the non-routine items.
- The concerns over the 2002 sample being 'representative' are perhaps further illustrated through the performances demonstrated across the three Units. In 2002, performance in Unit 3 was better than in the other two units, an unusual situation at any level but more so at this borderline C/D zone. In 2006 the pattern of performance was more in line with expectations, showing the Unit 3 to be weaker, very much a reflection of the mathematical content of that Unit.

- The only other change to note was in the marking instructions, as detailed above, something that may well have inflated the 2002 responses. In the small sample provided, had the new criteria been applied, there would have been a reduction of a few marks for some of those candidates.
- The Calculator/Non-Calculator Papers showed a small difference in the sample provided, with the 2006 performance being slightly better than their counterparts in 2002 on the non-calculator component. Overall these differences were very small and can only offer suggested areas for further research.

5.3 Specific weaknesses and strengths in scripts

The panel considered which aspects of the course were regarded as 'difficult' and looked closely at the candidate performance where there were comparable questions. Specific content areas worthy of highlighting are that, compared to 2002 scripts, candidates' performance in 2006 was stronger in the *Circle* and *Mean from a frequency table* questions; and weaker in the *Percentage increase* question.

Appendix 1 Distribution of candidates by stage

Percentage of Candidates by Stage

Year	Entries	S1	S2	S3	S4	S5	S6	Other
2002	5070							
2003	5321	0.0%	0.0%	1.0%	10.8%	78.9%	6.6%	2.7%
2004	5908	0.0%	0.0%	5.7%	22.2%	64.7%	5.1%	2.3%
2005	7885	0.0%	0.0%	13.6%	27.2%	52.0%	4.2%	3.0%
2006	10317	0.0%	2.4%	22.2%	30.1%	39.2%	3.4%	2.7%

Appendix 2 Entries and awards for each subject at Intermediate 1

All Candidates 2002 **Grade**

	Entries	A	B	C	Passes
Mathematics	5,070	690 (13.6%)	797 (15.7%)	1,011 (19.9%)	2,498 (49.3%)

All Candidates 2006 **Grade**

	Entries	A	B	C	Passes
Mathematics	10,317	3,201 (31.0%)	1,460 (14.2%)	1,747 (16.9%)	6,408 (62.1%)

Appendix 3 Percentage distribution of A/B and non-routine distribution in assessments

	2002		
	Non-routine	**Routine**	**Total**
A/B	14.1	19.2	33.3
C	21.8	44.9	66.7
Total	35.9	64.1	100

	2006		
	Non-routine	**Routine**	
A/B	20.0	12.5	32.5
C	17.5	50.0	67.5
	37.5	62.5	100

Appendix 4 Analysis of examinations by Unit content

	2002 Paper 1	Degree of difficulty	2002 Paper 2	Degree of difficulty	2006 Paper 1	Degree of difficulty	2006 Paper 2	Degree of difficulty
Unit 1 Outcome 1								
1.1. Basic calculations								
1.1.0 Calculation	1a, 1b	2 2			1	2		
1.1.1. find a percentage of a quantity	8	1	4b	2	4	2		
(calculate interest for fraction of a year) [A/B]							11	3
1.1.2. express one quantity as a percentage of another [A/B]			**10**	**2**			13	2
round calculations to a given degree of accuracy:								
1.1.3. . to nearest whole number			12	2				
1.1.4. . to nearest 10, 100, 1000							1	2
1.1.5. . to a given number of decimal places			7	2			14	2
1.1.6. solve simple problems on direct proportion	4	1					4	2
Unit 1 Outcome 2								
1.2. Basic geometric properties								
1.2.1. find the area of simple composite shapes								
(simple composite shapes including semi-circles) [A/B]			12	2			14	3
1.2.2. find the volumes of cubes and cuboids	2	2					6	3
1.2.3. find the area and circumference of a circle			8	2				
Unit 1 Outcome 3								
1.3. Expressions and formulae								
1.3.1. evaluate expressions	10	2						
1.3.2. evaluate formulae expressed in words					2	2		
1.3.3. evaluate simple formulae expressed in symbols								

	2002 Paper 1	Degree of difficulty	2002 Paper 2	Degree of difficulty	2006 Paper 1	Degree of difficulty	2006 Paper 2	Degree of difficulty
Unit 1 Outcome 4								
1.4. Calculations in everyday contexts								
1.4.1. carry out calculations involving money in appropriate social contexts	8	3			4 5	2 2		
use exchange rates to convert from:								
1.4.2. . pounds sterling to foreign currency			4a 4b	1 3			1	2
1.4.3. . foreign currency to pounds sterling [A/B]								
Unit 2 Outcome 1								
2.1. Integers								
2.1.1. plot and read coordinates in all four quadrants	7b	2			7b	2		
2.1.2. add and subtract positive and negative integers **(subtract a negative integer from an integer) [A/B]**	10	2			10a 10b 10c	1 2 3		
2.1.3. multiply two integers where one is positive and one is negative and divide a negative integer by a positive integer								
2.1.4. multiply and divide two integers where both are negative and multiply three or more integers [A/B]	10	2						

	2002 Paper 1	Degree of difficulty	2002 Paper 2	Degree of difficulty	2006 Paper 1	Degree of difficulty	2006 Paper 2	Degree of difficulty
Unit 2 Outcome 2								
2.2. Speed, distance and time								
2.2.1. interpret distance-time graphs								
2.2.2. recognise the significance of the point of intersection of two graphs, where the graphs are in context								
2.2.3. calculate time intervals, including those over midnight or midday on the 12-hour clock			6	3				
2.2.4. distance, speed, time - calculate one, given the other two			6	2	3	2		
Unit 2 Outcome 3								
2.3. The Theorem of Pythagoras								
2.3.1. solve problems in right-angled triangles using the Theorem of Pythagoras			8	3			9	2
Unit 2 Outcome 4								
2.4. Simple graphs, charts, tables								
2.4.1. extract and interpret data from bar graphs, line graphs, pie charts and stem-and-leaf diagrams	3a	2						
2.4.2. construct bar graphs, line graphs and stem-and-leaf diagrams			3a	2			10	3
2.4.3. interpret trends in graphs	3b	2						
2.4.4. construct a frequency table from data without class intervals								
2.4.5. construct and interpret a scattergraph								
2.4.6. draw a best-fitting straight line by eye on a scattergraph and use it to estimate the value of one variable given the other								

	2002 Paper 1	Degree of difficulty	2002 Paper 2	Degree of difficulty	2006 Paper 1	Degree of difficulty	2006 Paper 2	Degree of difficulty
Unit 2 Outcome 5								
2.5. Use of simple statistics								
2.5.1. calculate the mean, median, mode and range from a data set	9a 9b	2 2	3b	1			8a 8b	2 2
2.5.2. calculate the mean, median, mode and range of data presented in an ungrouped frequency table			7	2			5a 5c	2 2
2.5.3. interpret calculated statistics [A/B]	9c	2					**8c**	**2**
2.5.4. state the probability of a simple outcome			1	1			5b	2
Unit 3 Outcome 1								
3.1. Simple algebraic operations								
3.1.1. evaluate formulae expressed in symbols **[Includes A/B,** $P = I^2 R$ **,** $d = \sqrt{x^2 + y^2}$			**13a** **13b**	**2** **3**	**9**	**2**		
manipulate algebraic expressions involving brackets								
3.1.2. . multiply expressions								
3.1.3. . remove brackets and collect like terms			5a	2			7a	2
3.1.4. . factorise expressions - common factor			5b	2			7b	3
3.1.5. solve simple linear equations **(** $\frac{1}{3}x = 7$ **,** $x + 7 = 4x - 5$ **) [A/B]**	6	3			6	3		
3.1.6. solve simple inequalities			9	2			3	2
Unit 3 Outcome 2								
3.2. Graphical relationships								
3.2.1. know the equation $y = ax + b$ as the equation of a straight line .								
3.2.2. draw a straight line given its equation in the form $y = ax + b$ by drawing up a table of values	7	2			7	2		

	2002 Paper 1	Degree of difficulty	2002 Paper 2	Degree of difficulty	2006 Paper 1	Degree of difficulty	2006 Paper 2	Degree of difficulty
Unit 3 Outcome 3								
3.3. Trig. in a right-angled triangle								
3.3.1. solve right-angled triangles using sine, cosine and tangent			11	2			12	3
Unit 3 Outcome 4								
3.4. Standard form (scientific notation)								
3.4.1. interpret index notation, 10^n ,as used in standard form								
3.4.2. rewrite large and small numbers using standard form			2	2			2	2
3.4.3. interpret calculator display								
3.4.4. perform simple calculations using standard form								
3.5. Problem Solving	5a 5b	2 2			8	3		

Appendix 5 Degree of difficulty across 2002 and 2006 examinations

- Unit 1.1
  - 2002 slightly easier with two occurrences of '1' and 2006 highlighting a couple of '3' situations, making 2006 harder
- Unit 1.2
  - 2006 harder in semi-circle and volume questions
- Unit 1.3
  - no differences
- Unit 1.4
  - 2002 is harder on the insurance questions (involved a percentage and fraction); 2006 paper's opening question was an easy lead-in on currency
- Unit 2.1
  - Number cells in 2006 question involved a PS component that made it quite challenging; other references to 'integers' were incidental.
- Unit 2.2
  - SDT questions were made difficult in 2002 because of working backwards across midnight in time calculation. Only 1 mark, but acknowledged as a more difficult section than 2006
- Unit 2.3
  - 2002 question on Pythagoras was buried in a circle problem, hence deemed to be harder than the snooker equivalent which was just a basic triangle, the context not having a strong bearing on the solution. 2002 section is therefore harder.
- Unit 2.4
  - 2006 question required a lot more from candidates, having to select appropriate scales as well as deal with non-linear line graph (Speed/ Distance)
- Unit 2.5
  - Pretty much the same in this outcome; probability question in 2002 slightly easier but overall the questions were comparable.
- Unit 3.1
  - 'Body Mass' question (2002, Paper 2) involved working backwards, making this slightly more difficult than 2006 but overall the section is well balanced across the use of simple algebra.
- Unit 3.2
  - No difference
- Unit 3.3
  - 2006 on trigonometry (bridge) was more challenging than the bearings context in 2002.

- Unit 3.4
    - Very similar (almost identical in degree of difficulty)
- Unit 3.5 (Problem Solving)
    - 2006 question was more difficult, dealing with fractions of money AND minutes; 2002 question was limited to extracting data from a table.

Appendix 6 Grade boundaries 2002 & 2006

2002	**Max Mark**	**Upper A**	**A Mark**	**B Mark**	**C Mark**	**D Mark**
Mathematics Intermediate 1	78		55	46	38	35
			70.5%	59.0%	48.7%	44.9%

2006	**Max Mark**	**Upper A**	**A Mark**	**B Mark**	**C Mark**	**D Mark**
Mathematics Intermediate 1	80	68	56	48	40	36
		85%	70%	60%	50%	45%