

## **SCOTTISH QUALIFICATIONS AUTHORITY**

### **REPORT OF THE MATHEMATICS AND STATISTICS ASSESSMENT PANEL ON THE FALL IN PASS RATE OF COURSE AWARDS IN HIGHER MATHEMATICS IN SUMMER DIET 2002**

#### **Background**

In 2002 there was a fall of 4.7% in the pass rate in Higher Mathematics on the previous year. As a result SQA asked its Assessment Panel to conduct an investigation to ascertain the cause, or identify contributory factors for this reduction.

In the course of this investigation, SQA took account of submissions from Teacher Associations and surveys of centres. It also consulted a range of internal and external groups including HMIE, Principal Assessors, Examination Teams, the Mathematics and Statistics Assessment Panel and the Mathematics and Statistics Advisory Group. The inquiry included:

- An analysis of the 2002 Higher Mathematics Question Papers
- A review of the Quality Assurance procedures applied to Question Paper production and marking of Higher Mathematics
- A detailed analysis of progression statistics from Standard Grade and Intermediate 2 into Higher Mathematics
- An examination of the current use of Intermediate 2 by centres and possible future developments
- Consideration of the role of the National Assessment Bank in Mathematics
- The timing and duration of the Higher Mathematics examination.

The investigation concluded that there was no single factor that caused the fall in pass rate in 2002. However, in the course of the inquiry, a number of factors were identified, which when combined, may have contributed to the fall in pass rate

This paper sets out the factors that contributed to the fall in pass rate for Higher Mathematics in 2002. It also outlines some of the factors that affect performance in Mathematics in general.

It should be noted that SQA apply the same standards each year and do not operate a norm-referenced system. Therefore, in any given year the percentage of candidates gaining awards may fluctuate.

The report contains a number of recommendations for consideration.

## **Assessment Panel**

The Assessment Panel for Mathematics and Statistics was asked to identify and discuss any factors that may have contributed to the 4.7% fall in the Higher Mathematics pass rate seen in 2002. In the course of the investigation and ensuing debate a wide range of information and data was made available to the Panel, including pass mark data, progression routes and associated achievement levels and historical trends.

### **Issues: Factors affecting performance**

#### **Question Paper**

It is important to note that the 2002 Higher Mathematics Question Papers performed as intended. The examination was set at an appropriate level and sampled across the range of the course. The quality assurance aspects of SQA procedures were examined and found to have been carried out appropriately. The structure of the paper was similar to previous years with an appropriate proportion of questions from each of the levels. There was a slight increase in the number of 'C' type questions in this year's paper. Therefore the 2002 Higher Mathematics examination was judged to be slightly easier than 2001. This judgement was taken into consideration when setting the pass mark for the 2002 examination. The pass mark was set at 46% of the available marks. The mark required to gain an "A" was set at 74% of the marks. If the score of 50% for a "C" had been adopted, the pass rate would have been lower.

Reports received from the Examination Team and Markers confirmed their satisfaction with the standard and scope of the Question Papers. This was not reflected by candidate performance with a large number of lower scoring candidates evident. Reports from the SSTA Mathematics Subject Panel and the SQA Quality of Question Paper Survey of centres both concluded that the 2002 paper was of a satisfactory standard.

SQA also conducted an in-depth question paper analysis on Higher Mathematics. The analysis provided detail on a question by question basis and indicated relative performance of questions. The analysis confirmed that the question papers performed as intended.

#### **Presentations in Higher Mathematics**

The number of candidates being presented for Higher Mathematics dropped this year to 19770, a fall of almost 1000 candidates from 2001.

However an analysis of the two cohorts over 2001 and 2002 shows that the route through to Higher Mathematics is similar in both years. The following table shows the route to Higher for candidates in 2001 and 2002.

**Table 1: Main progression routes to Higher Mathematics for 2001 and 2002**

Qualification Level	Candidates in 2001	% of total	Candidates in 2002	% of total
SG Mathematics	14505	69.6	13903	70.3
Int 1 Mathematics	0	0	1	0
Int 2 Mathematics	1617	7.8	1624	8.2
Higher Mathematics (re-sit)	3274	15.7	2766	14.0
No previous record	1447	6.9	1476	7.5
<b>Total (Pre Appeal)</b>	<b>20843</b>	<b>100</b>	<b>19770</b>	<b>100</b>

Given that the entry figures are similar, it was necessary to conduct further detailed analysis on each level.

Progression rates were examined for candidates coming through to Higher Mathematics from Standard Grade, Intermediate 2 and Further Education. This analysis revealed a change in performance in some of these areas that has contributed to the fall in pass rate in 2002.

**Table 2: % of No Awards from different routes**

Route to Higher	Candidates in 2001	Candidates receiving No Award	Candidates in 2002	Candidates receiving No Award
Standard Grade	14505	2639 (18%)	13903	2907 (20%)
*Intermediate 2	1617	909 (56%)	1624	1033 (64%)
*S6	5563	2176 (39%)	4967	2449 (49%)
Further Education	422	181 (43%)	459	268 (58%)

\*It should be noted that almost all of the Intermediate 2 candidates who were presented for Higher Mathematics in 2002 were from S6. This is a clear indication that Intermediate 2 is not being used as a substitute for Standard Grade at this time.

Progression statistics in Mathematics from Standard Grade and Intermediate 2 to Higher are given in **Appendix 1**.

There is some evidence of poorer performance in comparison to 2001 from candidates coming through from Standard Grade, Intermediate 2 and from those attempting Higher Mathematics over two years (sitting the exam in S6) and in candidates from Further Education.

There are a number of conclusions that can be drawn from this data:

1. There has been a 2% increase in No Awards from candidates coming through to Higher from Standard Grade.
2. Candidates from Intermediate 2 are performing less well in Higher than those with Grades 1 and 2 from Standard Grade. The majority of candidates entered for Higher in 2002 after Intermediate 2 in 2001 progressed to Intermediate 2 from Standard Grade 3 or 4 and are potentially weaker candidates.

## **Progression from Intermediate 2 to Higher Mathematics**

There are a number of issues associated with progression to Higher Mathematics from Intermediate 2.

Firstly, it is possible for candidates to achieve a pass in Intermediate 2 Mathematics with a minimum exposure to the Intermediate 2 Unit 3. Unit 3 demands higher level algebra skills which are considered essential for progression to Higher Mathematics. In general, algebraic manipulation is weak throughout all levels – the PA reports for 2002 will highlight this as an area of weakness and will emphasise the need to address this issue. This however is not a new occurrence in 2002 and has been an issue in mathematics for a number of years.

Secondly, there is an unrealistic expectation on the part of candidates, parents and perhaps schools that candidates who achieve a Standard Grade 3 in S4 will be able to enter and achieve Intermediate 2 in S5 and then progress to Higher in S6. There is little evidence to support this as a reliable progression. In fact there is a great deal of evidence to the contrary which shows that 73% of candidates with a Standard Grade 3 who go on to attempt Higher will gain a No Award with 9% gaining a compensatory award. The Mathematics subject update letter scheduled for autumn 2002 will provide progression rate details for centres. (See Appendix 1 for further details).

There is another factor that is perhaps more prevalent in Mathematics and English than in other subjects and that is the issue of pressure. Pressure can be applied to allow a candidate to sit Higher Mathematics when there is little realistic chance of success. It is recognised that this is not a new occurrence in 2002 but it should, nevertheless, be noted as a possible contributory factor in the decline in pass rate.

### **Purpose of Intermediate2**

This investigation has led SQA to make a closer inspection of the way in which centres are making use of the Intermediate 2 qualification. It is apparent that there are three main ways in which centres are using the Intermediate 2 qualification in Mathematics:

- As an exit qualification
- As a progression route to Higher Mathematics for candidates who achieve Standard Grade level 3 or 4
- As a replacement for Standard Grade Mathematics

### **Exit qualification**

In 2001, 11792 candidates were entered for Intermediate 2 Mathematics, of which 1624 went on to Higher in 2002. This means that over 10,000 candidates used Intermediate 2 as an exit qualification. This was clearly one of the uses that Intermediate 2 was designed to fulfil and therefore already in year three of the qualification can be said to be very successful. These 10,000 candidates achieved a level in Mathematics that simply did not exist prior to the introduction of National Qualifications.

## **Progression route to Higher Mathematics for candidates who achieve Standard Grade level 3 or 4**

Some centres are using Intermediate 2 as a progression route to Higher Mathematics for candidates who achieve a General level award in Standard Grade. In 2002, 1624 Higher candidates came through this route. Though, as a group, these candidates are different from candidates in centres which replace Standard Grade with Intermediate 2, over 600 achieved a full Higher course award. This indicates that Intermediate 2 can be an appropriate progression route for candidates achieving a General level award, but that there are issues that require further investigation. It should be noted that almost all candidates who did not achieve a full course award at Higher did achieve all Higher units and this success was recorded on their certificates. The progression of candidates from Standard Grade 3 or 4 is well documented and is detailed in the Appendix.

## **A replacement for Standard Grade Mathematics**

Centres who opt to replace Standard Grade Mathematics with Intermediate 2 are at this time relatively few. The numbers are expected to increase next year and in future years as the effect of the relaxation of age and stage is realised. When these candidates come through to Higher there will be a clearly different situation to take account of as candidates who currently are presented for Credit are entered for Intermediate 2 in S4 then on to Higher in S5. It is our expectation that these candidates will perform as the current Credit level candidates do. This is an area that SQA will monitor closely to ensure that emerging trends are investigated.

## **Role of NABs in Mathematics**

NABs in Mathematics are all at minimum unit competence i.e. all of the questions within the NABs are deemed to be at level C and there is no headroom in Mathematics NABs.

The level, content and structure of the NABs in Mathematics as they presently exist can lead to false expectation on the part of candidates and parents and can contribute to the issue of inappropriate presentations. Candidates who in the past would not be presented on the basis of a poor Prelim performance and course work are now being entered on the basis of success in NABs. The existing NABs in Mathematics do not provide an adequate indicator of likely candidate performance in the external examination nor do they prepare candidates fully for the external assessment. This was an explicit design feature of these NABs.

It is difficult to make candidates and parents aware of the lack of headroom in NABs and in particular, the huge jump required to obtain an 'A' or 'B' in the (integrated) examination, after passing the Units at 'C' only.

The possibility of developing NABs that contain headroom and reflect the structure and make up of the final exam is being investigated. An initial paper has been prepared and further work has been commissioned to investigate this.

## **Timing and duration of Examination**

Traditionally, Higher Mathematics was in the early part of the Higher Diet. In 2002 the exam was moved further back into the diet. Mathematics is memory intensive and content driven and a longer

period away from teachers could have had a detrimental effect on candidates. For diet 2003, the exam has been moved back to the start of the Higher Diet.

The duration of the examination remains an unresolved issue in Mathematics. There is a consistent call from the Mathematics community for restitution to previous levels. In the current structure this would mean 3 hours of actual examination time as permitted in the Higher Still arrangements. At present the total time allocated for Higher Mathematics is 2 hours and 40 minutes with a 20 minute break to allow invigilators time to manage the change of papers. The proposal is to increase the actual examination time to 3 hours with a 10 or 20 minute break for administration purposes (this is currently the case in English and Communication). An increase in time would provide candidates more thinking time and prevent a headlong rush in to the paper. An increase in time would also allow the examination team to provide wider and more appropriate syllabus coverage.

Another possible option that is available would be to increase the total number of marks available in the Higher examination. The current number of marks for Higher is 110. This total could be increased to 120 or 130.

This would have the advantage of giving more credit to core topics at an appropriate level, thus making it easier for candidates on the interfaces of C/B and B/A to demonstrate their competence.

It should be noted that the structure and timing of the examination in Mathematics is one of the recommendations that has to be taken forward as part of the NQ Review in Mathematics. Both of these changes could be made quickly and could have a positive effect on performance in Mathematics. It may be possible to conduct further analysis to investigate the actual effect of this on candidates. This would involve SQA selecting a significant sample of scripts and amending the marking scheme to reflect an increase in marks to 120. The amended scheme would be applied to the scripts and an analysis of the results conducted.

## **Recommendations**

- Qualifications Manager to issue a subject update letter which communicates directly with centres and provides detailed information on the following:
  - Progression rates data: Standard Grade and Intermediate 2 to Higher
  - Appropriate presentations: advice to centres
- SQA should issue Principal Assessor reports to centres that will contain full finalised marking schemes to assist with exemplification of standards
- SQA should consider conducting a series of regional seminars to specifically address the issue of exemplification of standards
- SQA should monitor the progress of Intermediate 2 candidates from centres where Intermediate courses have replaced Standard Grade. This will assist SQA in identifying emerging trends
- SQA should investigate the possibility of:
  - increasing time for the Higher Mathematics examination to 3 hours of examination time
  - increasing the number of marks available for the Higher Mathematics examination

**Appendix 1: Progression rates for candidates from Standard Grade and Intermediate 2 to Higher Mathematics**

**Progression in Mathematics: Standard Grade (2000) to Higher (2001)**

		Higher Mathematics Result 2001 (Pre-Appeal)											
		A		B		C		Comp	No Award		No Result		Total
		1	2	3	4	5	6	76	8	9	No Result		
<b>SG Mathematics Result 2000</b>	<b>1</b>	1,486	1,654	1,715	1,559	1,259	878	536	326	256	47	9,716	
	<b>2</b>	10	53	147	372	604	746	746	624	906	196	4,404	
	<b>3</b>	0	0	0	7	16	41	36	66	179	36	381	
	<b>4</b>	0	0	0	0	0	1	0	0	3	0	4	
<b>Total</b>		1,496	1,707	1,862	1,938	1,879	1,666	1,318	1,016	1,344	279	14,505	

		Higher Mathematics Result 2001 (Pre-Appeal)											
		A		B		C		Comp	No Award		No Result		Total
		1	2	3	4	5	6	76	8	9	No Result		
<b>SG Mathematics Result 2000</b>	<b>1</b>	15%	17%	18%	16%	13%	9%	6%	3%	3%	0%	100%	
	<b>2</b>	0%	1%	3%	8%	14%	17%	17%	14%	21%	4%	100%	
	<b>3</b>	0%	0%	0%	2%	4%	11%	9%	17%	47%	9%	100%	
	<b>4</b>	0%	0%	0%	0%	0%	25%	0%	0%	75%	0%	100%	
<b>Total</b>		10%	12%	13%	13%	13%	11%	9%	7%	9%	2%	100%	

**Progression in Mathematics: Intermediate 2 (2000) to Higher (2001)**

		Higher Mathematics Result 2001 (Pre-Appeal)										
		A		B		C		Comp	No Award		No Result	
		1	2	3	4	5	6	76	8	9	No Result	Total
<b>Int 2 Mathematics Result 2000</b>	<b>A</b>	2	17	39	80	101	111	107	94	119	36	706
	<b>B</b>	1	2	6	17	33	52	72	108	193	56	540
	<b>C</b>	0	0	0	2	8	16	26	33	155	43	283
	<b>Comp No Award</b>	0	0	0	0	1	2	2	4	25	8	42
	<b>Total</b>	0	0	1	0	2	1	3	8	17	14	46
<b>Total</b>		3	19	46	99	145	182	210	247	509	157	1,617

		Higher Mathematics Result 2001 (Pre-Appeal)										
		A		B		C		Comp	No Award		No Result	
		1	2	3	4	5	6	76	8	9	No Result	Total
<b>Int 2 Mathematics Result 2000</b>	<b>A</b>	0%	2%	6%	11%	14%	16%	15%	13%	17%	5%	100%
	<b>B</b>	0%	0%	1%	3%	6%	10%	13%	20%	36%	10%	100%
	<b>C</b>	0%	0%	0%	1%	3%	6%	9%	12%	55%	15%	100%
	<b>Comp No Award</b>	0%	0%	0%	0%	2%	5%	5%	10%	60%	19%	100%
	<b>Total</b>	0%	0%	2%	0%	4%	2%	7%	17%	37%	30%	100%
<b>Total</b>		0%	1%	3%	6%	9%	11%	13%	15%	31%	10%	100%

**Progression in Mathematics: Standard Grade (2001) to Higher (2002)**

		Higher Mathematics Result 2002 (Pre-Appeal)											
		A		B		C		Comp	No Award		No Result		Total
		1	2	3	4	5	6	76	8	9	No Result		
<b>SG Mathematics Result 2001</b>	<b>1</b>	1,333	1,928	1,542	1,245	1,298	889	679	317	436	55	9,722	
	<b>2</b>	4	45	136	204	455	556	601	524	1,212	174	3,911	
	<b>3</b>	0	0	1	6	15	19	40	28	141	16	266	
	<b>4</b>	0	0	0	0	0	0	0	0	3	1	4	
<b>Total</b>		1,337	1,973	1,679	1,455	1,768	1,464	1,320	869	1,792	246	13,903	

		Higher Mathematics Result 2002 (Pre-Appeal)											
		A		B		C		Comp	No Award		No Result		Total
		1	2	3	4	5	6	76	8	9	No Result		
<b>SG Mathematics Result 2001</b>	<b>1</b>	14%	20%	16%	13%	13%	9%	7%	3%	4%	1%	100%	
	<b>2</b>	0%	1%	3%	5%	12%	14%	15%	13%	31%	4%	100%	
	<b>3</b>	0%	0%	0%	2%	6%	7%	15%	11%	53%	6%	100%	
	<b>4</b>	0%	0%	0%	0%	0%	0%	0%	0%	75%	25%	100%	
<b>Total</b>		10%	14%	12%	10%	13%	11%	9%	6%	13%	2%	100%	

**Progression in Mathematics: Intermediate 2 (2001) to Higher (2002)**

		Higher Mathematics Result 2002 (Pre-Appeal)										
		A		B		C		Comp	No Award		No Result	
		1	2	3	4	5	6	76	8	9	No Result	Total
<b>Int 2 Mathematics Result 2001</b>	<b>A</b>	2	15	26	36	75	91	68	82	153	13	561
	<b>B</b>	0	5	5	11	40	62	86	92	290	43	634
	<b>C</b>	0	0	3	3	9	8	32	40	207	32	334
	<b>Comp</b>	0	0	1	0	0	0	4	4	32	7	48
	<b>No Award</b>	1	1	0	0	1	1	5	3	28	7	47
<b>Total</b>		3	21	35	50	125	162	195	221	710	102	1,624

		Higher Mathematics Result 2002 (Pre-Appeal)										
		A		B		C		Comp	No Award		No Result	
		1	2	3	4	5	6	76	8	9	No Result	Total
<b>Int 2 Mathematics Result 2001</b>	<b>A</b>	0%	3%	5%	6%	13%	16%	12%	15%	27%	2%	100%
	<b>B</b>	0%	1%	1%	2%	6%	10%	14%	15%	46%	7%	100%
	<b>C</b>	0%	0%	1%	1%	3%	2%	10%	12%	62%	10%	100%
	<b>Comp</b>	0%	0%	2%	0%	0%	0%	8%	8%	67%	15%	100%
	<b>No Award</b>	2%	2%	0%	0%	2%	2%	11%	6%	60%	15%	100%
<b>Total</b>		0%	1%	2%	3%	8%	10%	12%	14%	44%	6%	100%