Course report 2022

Subject	Mathematics
Level	Higher

This report provides information on candidates’ performance. Teachers, lecturers and assessors may find it useful when preparing candidates for future assessment. The report is intended to be constructive and informative and to promote better understanding. It would be helpful to read this report in conjunction with the published assessment documents and marking instructions.

The statistics used in this report have been compiled before the completion of any appeals.

Grade boundary and statistical information

Statistical information: update on courses

Number of resulted entries in 2022	**18050**

Statistical information: performance of candidates

Distribution of course awards including grade boundaries

A	Percentage	45.9	Cumulative percentage	45.9	Number of candidates	8285	Minimum mark required	84
B	Percentage	16.8	Cumulative percentage	62.7	Number of candidates	3025	Minimum mark required	70
C	Percentage	12.6	Cumulative percentage	75.3	Number of candidates	2285	Minimum mark required	57
D	Percentage	9.5	Cumulative percentage	84.8	Number of candidates	1715	Minimum mark required	43
No award	Percentage	15.2	Cumulative percentage	N/A	Number of candidates	2745	Minimum mark required	N/A

You can read the general commentary on grade boundaries in appendix 1 of this report.

In this report:

- ‘most’ means greater than 70%
- ‘many’ means 50% to 69%
- ‘some’ means 25% to 49%
- ‘a few’ means less than 25%

You can find more statistical reports on the statistics page of [SQA’s website].

Section 1: comments on the assessment

The course assessment largely performed as expected and proved accessible to most candidates. Feedback from markers and centres suggests the assessment was fair and provided the appropriate level of breadth and challenge at this level. Candidates had good opportunities to demonstrate their knowledge and understanding of the course. The grade boundary was lowered slightly to take account of the higher demand in some questions.

Many candidates were well prepared and had made good use of the modification summary document to focus their revision. As a result, there was a substantial increase in the number of candidates achieving higher marks than in previous years.

Question paper 1 (non-calculator)

This paper performed as expected. Most candidates made a good attempt at all questions. Candidates lost marks because of numerical inaccuracies throughout the paper.

Question paper 2

This paper performed largely as expected, except for questions 2, 3(b), and 5(b), which were more demanding than anticipated. Most candidates made a good attempt at all questions apart from 8(a).

Section 2: comments on candidate performance

Question paper 1 (non-calculator)

Question 1 **Determining equation of perpendicular line**

Many candidates achieved full marks. However, some candidates were unable to identify the gradient of the original line correctly or made an error when simplifying the constant terms.

Question 2 **Evaluating logarithms**

Most candidates achieved full marks.

Question 3 **Determining the inverse function**

Many candidates achieved full marks. Where candidates chose to use method 2, many lost marks because of errors made when expressing x in terms of y, for example:

$$y = 4 + \frac{1}{3}x \Rightarrow 3y = 4 + x$$

Many candidates using method 2 also lost marks by writing conflicting expressions for y in the same solution, for example:

$y = 4 + \frac{1}{3}x$ and $y = 3(x - 4)$

Question 4 **Differentiating powers of x**

Most candidates achieved full marks.

Question 5 **Using $m = \tan\theta$ to calculate the gradient**

A few candidates were able to identify the correct angle required to calculate the gradient. Many candidates failed to appreciate that the angle given in the diagram was not the angle the line made with the positive direction of the x-axis.

Question 6 **Calculating a definite integral**

Many candidates failed to deal with the coefficient of x correctly. A few candidates were able to carry out the numerical evaluation of the integral correctly.

Question 7 **Applying the addition formulae**

Many candidates achieved full marks. Some candidates lost marks through numerical inaccuracies such as:

$$\frac{2}{\sqrt{13}} \times \frac{1}{\sqrt{10}} = \frac{3}{\sqrt{130}}$$

Question 9 **Applying the double angle formula for $\cos 2x$**

This should have been a familiar question to most candidates, however, some candidates either were unable to begin the question or did not progress beyond the first mark. Weak algebraic skills were evident throughout. Some candidates were able to solve the quadratic equation in terms of $\cos x$ but unable to then solve it correctly for x.

Question 12 **Applying the chain rule to a composite function**

Few candidates obtained full marks for this question. Many candidates gave partial solutions, for example:

$$f'(x) = 4\cos\left(3x - \frac{\pi}{3}\right)$$

This was despite the standard derivative for the expression appearing on the formulae list. Other common errors were changing from radians to degrees before differentiating the function, and not evaluating the final expression correctly.

Question 13a **Solving a cubic equation**

Most candidates achieved full marks.

Question 14b **Applying properties of the circle**

This was intended to be a more challenging question. Where candidates attempted to sketch the situation, they were usually able to gain one of the two marks available. Very few candidates were able to interpret the situation where the circles touched internally.

Question paper 2

Question 1 **Using properties of medians and altitudes**

Most candidates achieved full marks for parts (a) and (b). However, some candidates were unable to solve the resultant simultaneous equations correctly in part (c). Where candidates chose to equate their expressions from (a) and (b) rather than try to solve by elimination, they were generally more successful. Some candidates also lost marks by not simplifying their final answer, for example, the following was common:

$$x = \frac{10}{4}$$

Question 2 **Using the discriminant**

Candidates made basic algebraic and numerical errors throughout this question. Candidates often lacked rigour in writing their expression for the discriminant, for example, a common response was:

$$-8^2 - 4(2)(4 - p)$$

Candidates made errors in processing negative numbers when expanding brackets, for example, a common error was:

$$64 - 32 - 8p$$

Some candidates stated the wrong condition and solved an equation rather than an inequation. Many candidates were unable to solve the linear inequation correctly, with some confusing this with a quadratic inequality.

Question 3 **Using the wave function and solving a trigonometric equation in radians**

Many candidates chose to work in degrees throughout parts (a) and (b) rather than work in radians. Only some candidates gave the final expression in part (a) in radians. In part (b), candidates were often unable to make any further progress beyond the first mark. Where candidates solved the equation, some failed to consider more than one possible solution.

Question 4 **Finding the area under a curve**

In part (a), many candidates evaluated individual terms rather than using the calculator efficiently. Working often lacked rigour. Candidates often missed the 'dx' when stating an appropriate integral. They also often missed brackets when substituting for -1. For example, the following was common:

$$\frac{-1^4}{4}\ldots$$

This led to an error in the evaluation of the integral.

In part (b), many candidates failed to deal with the area under the x-axis appropriately. Incorrect statements such as the following were common:

$$-\frac{16}{3}=\frac{16}{3} \text{ units squared}$$

Question 5a **Identifying composite functions**

Most candidates achieved full marks.

Question 5b **Solving a quadratic inequality**

Many candidates failed to use a sketch to justify the solution to the quadratic inequation. Some candidates worked with an equation from the outset. Errors in basic algebraic skills were common when attempting to express the inequality in standard quadratic form.

Question 6 **Solving a differential equation**

Most candidates attempted this question. However, some candidates omitted the '$+c$' and were unable to access all the marks. There was a lack of rigour in some candidates' solutions. Some candidates failed to complete their integration in one line of working or integrated individual terms in separate lines of working, for example:

$$y=x-3x^{-2} \Rightarrow y=x+3x^{-1}+c$$

Question 7 **Using a straight-line graph to confirm a relationship of the form** $y=kx^n$

There was a slight improvement in this question compared with previous years, however, many candidates still found this a challenging question and were unable to make a valid attempt at the question. Some candidates appear to have learnt a 'rote' method for tackling such questions but are often unable to reproduce the steps accurately. There was some evidence that candidates using the approach detailed in method 1 or method 2 in the marking instructions were more successful.

Question 8a **Determining an expression for area**

Few candidates made significant progress with this question. There were candidates who scored five or six out of six in part (b) who made no attempt at part (a).

Question 10 **Using an exponential equation**

Most candidates answered part (a) correctly, although many included unnecessary additional steps in their working. In part (b), candidates made errors applying the laws of logarithms, and few candidates were able to solve the exponential equation successfully.

Section 3: preparing candidates for future assessment

Most candidates were well prepared and attempted most questions. Working was often well set out and many candidates gave solutions in a clear and concise manner. However, some candidates' solutions were not well structured, and were poorly set out. For some candidates, their handwriting and layout of their solutions was very poor, which led to working that was difficult to read and interpret. As a result, candidates made additional errors and lost marks. You should bear this in mind when preparing candidates for future assessment.

Question papers 1 and 2 — non-calculator and calculator

The following advice may help prepare future candidates for the Higher question papers. In particular, teachers and lecturers should:

- make sure candidates maintain their basic numeracy skills and practise them regularly, particularly fractions and negative numbers
- encourage candidates to check their final answers carefully and simplify final answers where appropriate
- encourage candidates to set out their working in a structured and logical manner, where each line of working follows logically from the line above — this is particularly important when differentiating and integrating, and working with logarithms and exponentials
- encourage candidates to use notation and symbols — for example, integral notation — accurately throughout the course
- encourage candidates to use brackets appropriately throughout the course, particularly when completing the square and substituting negative numbers into formulae
- consider how to best practise using radian measure and the exact values of trigonometric ratios
- where teaching algorithms that arrive at the correct final answer, give attention to the intervening steps — for example, when factorising a quadratic solution, statements such as the following are not consistent from line to line and do not gain full credit:
  $2x^2-5x+2=x^2-5x+4=(x-1)(x-4)=(2x-1)(x-2)$
- encourage candidates to use a calculator efficiently in paper 2

Teachers and lecturers delivering the Higher Mathematics course, and candidates undertaking the course, can consult the detailed marking instructions for the 2022 question papers on SQA's website. These illustrate the requirements in questions on, for example, determining inverse functions, and evaluating areas below the *x*-axis. The website also contains the marking instructions from previous years.

Appendix 1: general commentary on grade boundaries

SQA's main aim when setting grade boundaries is to be fair to candidates across all subjects and levels and maintain comparable standards across the years, even as arrangements evolve and change.

For most National Courses, SQA aims to set examinations and other external assessments and create marking instructions that allow:

- a competent candidate to score a minimum of 50% of the available marks (the notional grade C boundary)
- a well-prepared, very competent candidate to score at least 70% of the available marks (the notional grade A boundary)

It is very challenging to get the standard on target every year, in every subject at every level. Therefore, SQA holds a grade boundary meeting for each course to bring together all the information available (statistical and qualitative) and to make final decisions on grade boundaries based on this information. Members of SQA's Executive Management Team normally chair these meetings.

Principal assessors utilise their subject expertise to evaluate the performance of the assessment and propose suitable grade boundaries based on the full range of evidence. SQA can adjust the grade boundaries as a result of the discussion at these meetings. This allows the pass rate to be unaffected in circumstances where there is evidence that the question paper or other assessment has been more, or less, difficult than usual.

- The grade boundaries can be adjusted downwards if there is evidence that the question paper or other assessment has been more difficult than usual.
- The grade boundaries can be adjusted upwards if there is evidence that the question paper or other assessment has been less difficult than usual.
- Where levels of difficulty are comparable to previous years, similar grade boundaries are maintained.

Grade boundaries from question papers in the same subject at the same level tend to be marginally different year on year. This is because the specific questions, and the mix of questions, are different and this has an impact on candidate performance.

This year, a package of support measures including assessment modifications and revision support, was introduced to support candidates as they returned to formal national exams and other forms of external assessment. This was designed to address the ongoing disruption to learning and teaching that young people have experienced as a result of the COVID-19 pandemic. In addition, SQA adopted a more generous approach to grading for National 5, Higher and Advanced Higher courses than it would do in a normal exam year, to help ensure fairness for candidates while maintaining standards. This is in recognition of the fact that those preparing for and sitting exams have done so in very different circumstances from those who sat exams in 2019.

The key difference this year is that decisions about where the grade boundaries have been set have also been influenced, where necessary and where appropriate, by the unique circumstances in 2022. On a course-by-course basis, SQA has determined grade boundaries in a way that is fair to candidates, taking into account how the assessment (exams and coursework) has functioned and the impact of assessment modifications and revision support.

The grade boundaries used in 2022 relate to the specific experience of this year's cohort and should not be used by centres if these assessments are used in the future for exam preparation.

For full details of the approach please refer to the National Qualifications 2022 Awarding — Methodology Report.