Course report 2019

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 post-results services.

Section 1: comments on the assessment

The course assessment was accessible to the majority of candidates. Feedback from markers and teachers suggests that it gave candidates a good opportunity to demonstrate the breadth and depth of their skills and knowledge at this level.

The course assessment performed largely as expected, but the overall level of demand was higher than expected at C. The level of demand was also slightly higher than expected for A candidates. The grade boundaries for C, A and upper A were adjusted to take account of this.

Question paper 1 (non-calculator)

This paper performed largely as expected, except for questions 9(b), 12(b) and 17(b), which candidates found more demanding than expected. The majority of candidates made a good attempt at all questions, apart from 9(b), 16(b) and 17. Numerical inaccuracies cost candidates marks throughout the paper.

Question paper 2

This paper performed largely as expected, apart from questions 7(b) and 8(b), which candidates found more demanding than expected. Most candidates made a good attempt at all questions apart from 8(b) and 11(a).

Section 2: comments on candidate performance

Areas that candidates performed well in

Question paper 1 (non-calculator)

Candidates performed well in the following questions:

Question 1 **Determining stationary points**
The majority of candidates gained full marks, although a surprising number of candidates were unable to process $2x^2 = 0$ successfully.

Question 2 **Using the discriminant**
Most candidates gained full marks.

Question 3 **Finding the equation of a circle**
Most candidates gained full marks.

Question 6 **Using the chain rule**
The majority of candidates gained full marks.

Question 12a **Identifying composite function**
The majority of candidates gained full marks, with very few misinterpreting the question as $g\left(f\left(x\right)\right)$.

Question 13 **Application of addition formulae**
Most candidates answered this question well, although many were unable to work with surds successfully to gain the final mark in part (b).

Question 14 **Using the laws of logarithms**
Most candidates answered this question well.

Question paper 2

Question 1 **Median and altitude**
Most candidates answered this question well. However, careless errors cost candidates marks throughout the question.

Question 2 **Indefinite integral**
Most candidates answered this question well. However, candidates lost marks for omitting '$+c$' or failing to simplify fractions correctly.

Question 3 **Identifying vector pathways**
The majority of candidates gained full marks.

Question 4 **Recurrence relations**
Most candidates answered this question well, although many did not interpret the percentage decrease correctly. In part (b)(i), some candidates were unaware that a mathematical response was required.

Question 6a **Wave function**
The majority of candidates gained full marks. Fewer candidates than in previous years omitted 'k' at mark 2.

Question 9 **Exponential equation**
Most candidates made a good attempt at this question. However, several candidates interpreted 'initially' as '$t = 1$'.

Question 10a **Identifying factor of polynomial**
The majority of candidates gained full marks.

Question 11b **Optimisation**
Most candidates attempted part (b). There was an improvement in the standard of nature tables, which the majority of candidates labelled clearly and accurately.
$\sqrt[3]{125} = \pm 5$ was a common error.

Question 15 **Equation of tangent to a circle**
Most candidates answered parts (a) and b(i) well. Those who persevered to the end of the paper usually picked up most of these marks.

Areas that candidates found demanding

Question paper 1 (non-calculator)

Question 4b **Recurrence relations**
Many candidates were unable to process $\frac{2}{3} \times 11 + 5$ correctly.

Question 5a **Demonstrating collinearity**
Communication at mark 3 was poor. There was confusion between points and vectors. Responses such as 'points are parallel' and 'vectors are collinear' were very common.

Question 8 **Area between curves**
In part (a), many candidates were either unable to express the area as an integral or made a number of basic errors, including:

- omitting limits and/or 'dx' from the expression for area
- lack of brackets leading to an incorrect simplified expression

In part (b), many candidates struggled to process the limits correctly, or failed to simplify their final answer to gain the final mark.

Question 9b **Parallel vectors**
Very few candidates knew the condition for vectors to be parallel. Many candidates attempted to solve $\mathbf{u}.\mathbf{v} = 1$.

Question 11 **Calculating definite integral**
Although the majority of candidates attempted this question, many solutions contained basic errors. Common errors were:

- changing radians to degrees before integrating
- mixing radians and degrees within the same expression, for example: $\frac{1}{3}\sin\left(3\times\frac{\pi}{9}-30\right)\ldots$
- assuming $\frac{1}{3}\sin\left(3\times 0-\frac{\pi}{6}\right)$ evaluated to zero

Question 12b **Identifying range**

Few candidates were able to identify the range of values of x for which the composite function was undefined. Candidates considered either 'dividing by zero' or 'square root of negative', but few considered both.

Question 16b **Solving quadratic inequality**

Many candidates failed to state or were unable to form a correct inequation. Candidates often interpreted $(k+6)(k-2)>0$ as $k+6>0$ and $k-2>0$. Few candidates gave a valid justification for their given range.

Question 17 **Using trigonmetric identities**

Many candidates were unable to apply skills from a lower level in this question. Common errors included:

- expressing $\sin^2 x$ as $\sin x^2$
- expanding $(\sin x-\cos x)^2$ as $\sin^2 x-\cos^2 x$
- failing to use double angle formula to simplify $2\sin x\cos x$

Question paper 2

Question 6b **Solving trigonometric equation**

Despite having the correct solution from (a), many candidates struggled to reach a correct solution in (b). They found it difficult to deal with angles that were outwith the given range, and lying anywhere other than in the first quadrant.

Question 7 **Completing the square and decreasing function**

In part (a), many candidates still found it difficult to produce working that followed logically from one line to the next. Common errors included:

- errors in processing common factor. $-6(x^2+4x)-25$ was a common response at mark 1
- lack of rigour in use of brackets to process constant, for example writing $-6(x-2)^2-4-25$ instead of $-6\left((x-2)^2-4\right)-25$

In part (b), the majority of candidates gained mark 4, but few were able to give a satisfactory explanation to show that $f(x)$ was strictly decreasing.
Candidates' solutions lacked rigour, and a number appeared to be writing sentences from memory without reference to the particular question.

Question 8 **Inverse functions**

In part (a), a number of candidates rearranged the function in terms of *y*, and then gave conflicting expressions for *y*, for example:

$y=\sqrt[3]{x}+8$ and $y=(x-8)^3$.

There were also errors in interpreting $\sqrt[3]{x}$ as $x^{\frac{3}{2}}$.

In part (b), very few candidates understood the link between the range of $f(x)$ and the domain of $f^{-1}(x)$.

Question 10b **Factorising quartic expression**

The majority of candidates were able to identify the correct quadratic factor, but very few attempted to evaluate the discriminant to show that the quadratic could not be factorised further.

Question 11a **Determining expression for surface area**

In part (a), very few candidates knew how to find an expression for the surface area of the box. Many did not consider the surface area of the tunnel in their solution.

Question 12 **Equation from log graph**

Many candidates appeared to have no real understanding of how to proceed with this question, and failed to use a valid method. Some candidates started from an equation of the form $y=kx^n$ rather than $y=ab^x$.

Question 13 **Differential equation**

For candidates that interpreted ‘rate of change’ correctly, many were able to score full marks. However, many candidates were unable to make a valid attempt at this question. Missing ‘$+c$’ cost some candidates marks when attempting to evaluate the constant.

Question 14 **Using properties of scalar product**

Many candidates were unable to apply the properties of the distributive law to the scalar product. Common errors included:

- $\mathbf{u.u}=\mathbf{u}^2$ at mark 1
- $\mathbf{u.u}=4$ at mark 2

Question 15b **Equation of circle**

Few candidates interpreted the geometry of the diagram correctly. Many candidates assumed PT was the diameter of the circle.

Section 3: preparing candidates for future assessment

The majority of 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, too many candidates' solutions were not well structured, and were poorly set out.

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:

- encourage candidates to check arithmetic calculations carefully, and to simplify their final answers when appropriate (this is important as valuable marks continue to be lost through numerical inaccuracies in paper 1)
- consider how best to maintain and practise arithmetic skills when preparing candidates for the course assessment
- encourage candidates to use brackets appropriately throughout the course, particularly when completing the square and when substituting negative numbers into formulae
- consider how best to consolidate the skills introduced at National 5, including working with surds and indices, completing the square, and trigonometric identities
- encourage candidates to show clear and rigorous communication in their solutions, including the accurate use of notation and symbols — each line of working should follow logically from the line above
- consider how best to tackle problem solving that candidates require to access non-routine parts of questions

Teachers and lecturers delivering the Higher Mathematics course, and candidates undertaking the course, can consult the detailed marking instructions for the 2019 course assessment on SQA's website. These illustrate the requirements in questions on, for example, collinearity, and increasing or decreasing functions. The website also contains the marking instructions from previous years.

Grade boundary and statistical information:

Statistical information: update on courses

Number of resulted entries in 2018	18753

Number of resulted entries in 2019	18626

Statistical information: performance of candidates

Distribution of course awards including grade boundaries

Distribution of course awards	Percentage	Cumulative %	Number of candidates	Lowest mark
Maximum mark				
A	32.9%	32.9%	6127	101
B	21.5%	54.4%	3998	83
C	18.0%	72.4%	3356	66
D	13.9%	86.2%	2580	48
No award	13.8%	-	2565	-

General commentary on grade boundaries

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

SQA aims to set examinations and create marking instructions that allow:

- a competent candidate to score a minimum of 50% of the available marks (the notional C boundary)
- a well-prepared, very competent candidate to score at least 70% of the available marks (the notional 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 every year for each subject at each level to bring together all the information available (statistical and judgemental). The principal assessor and SQA qualifications manager meet with the relevant SQA head of service and statistician to discuss the evidence and make decisions. Members of the SQA management team chair these meetings. SQA can adjust the grade boundaries as a result of the meetings. This allows the pass rate to be unaffected in circumstances where there is evidence that the question paper has been more, or less, challenging than usual.

- The grade boundaries can be adjusted downwards if there is evidence that the question paper is more challenging than usual.
- The grade boundaries can be adjusted upwards if there is evidence that the exam is less challenging than usual.
- Where standards 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 to year. This is because the particular questions, and the mix of questions, are different. This is also the case for question papers set by centres. If SQA alters a boundary, this does not mean that centres should necessarily alter their boundary in the question papers that they set themselves.