Course Report 2018

Subject	Mathematics
Level	Higher

This report provides information on the performance of candidates. 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

Summary of the course assessment

The course assessment largely performed as expected, with most questions accessible to the majority of candidates. Feedback from markers and teachers suggests that it gave candidates a good opportunity to demonstrate knowledge and skills. The overall level of demand was more than expected at level C, and less than expected at levels A and upper A. The grade boundaries for C, A and upper A were amended to take account of this.

Component 1: question paper — paper 1 (non-calculator)

This paper performed as expected except for questions 5(b), 9(b) and 11(a), which candidates found more demanding than expected. Most candidates made a good attempt at all questions, but numerical inaccuracy resulted in candidates losing marks in some questions.

Component 2: question paper — paper 2

This paper performed as expected except for questions 8(b)(i) and 8(b)(ii), which candidates found more demanding than expected. Most candidates made a good attempt at all questions apart from 8(b)(i), 8(b)(ii) and 12(c).

Section 2: comments on candidate performance

Areas in which candidates performed well

Most candidates showed appropriate working, but some candidates' working was poorly presented and lacked rigour. Often one line of working did not follow logically from the line above.

Some candidates achieved very high marks, but others scored very low marks and were perhaps inappropriately presented at this level.

Component 1: question paper — paper 1 (non-calculator)

Question 1: **Equation of median**
Most candidates scored full marks for this question. Some candidates thought the median was perpendicular to the side PQ.

Question 2: **Inverse function**
The majority of candidates were able to find a formula for the inverse function. However, strategies employed often lacked rigour between one line of working and the next. It was not uncommon to see $g(x)=\frac{1}{5}x-4$, $g(x)=5x+20$ and $g^{-1}(x)=5x+20$ all appear in the same solution.

Question 3: **Chain rule**
Most candidates answered this question well. Some candidates did not evaluate the derivative correctly or did not simplify their final answer. $-\frac{6\sqrt{3}}{2}$ was a common response for the final mark.

Question 4: **Tangent to a circle**
The majority of candidates answered this question well and very few left their final answer in an unsimplified form.

Question 6: **Use laws of logarithms**
Most candidates answered this question well. This continues the trend for this type of question in recent years.

Question 8: **Use of gradient to find an angle**
Most candidates achieved full marks for this question. However, some candidates stated $\tan\left(\sqrt{3}\right)=60°$.

Question 10: **Solving differential equation**
Many candidates achieved full marks for this question. Having calculated the value of c, some candidates did not express y in terms of x.

Question 13: **Application of double angle formulae**

Most candidates were able to employ the correct strategy for each part of the question. However, candidates frequently made errors in calculating $\cos x$ in (a). $\cos x = \frac{7}{\sqrt{11}}$ and $\cos x = \frac{\sqrt{15}}{\sqrt{11}}$ were common responses.

Some candidates were unable to multiply fractions together or to multiply surds correctly. Common errors were $2 \times \frac{2\sqrt{7}}{11} = \frac{4\sqrt{7}}{22}$ and $\sqrt{11} \times \sqrt{11} = \sqrt{11}$.

Component 2: question paper — paper 2

Question 1: **Area between curve and x-axis**

Most candidates answered this question well. However, some candidates omitted dx at mark 1.

Question 2(b): **Determine angle between two vectors**

Most candidates made few errors in this question. For some candidates, there was a lack of rigour in their working to calculate the magnitude of each vector.

Question 3: **Determine whether *f* is increasing or decreasing**

Most candidates achieved full marks. Some candidates simply substituted $x = 2$ into the original function.

Question 5: **Perpendicular bisector and equation of circle**

Most candidates answered this question well. In 5(b), most candidates did not use the most efficient method of substitution, $3(x-5) + x = 25$, to solve the simultaneous equations. In 5(c), some candidates were unable to determine the radius.

Question 6(a): **Composite functions**

Most candidates achieved full marks for this part of the question.

Question 7(a): **Factorising a cubic**

Most candidates answered this question well. However, in 7(a)(ii) a surprising number of candidates interpreted the coefficient of x incorrectly and expressed the quadratic factor as $2x^2 - x - 1$.

Question 8(a): **Wave function**

Most candidates answered this question well. Some candidates did not interpret the phase angle correctly. $\sqrt{5}\cos(x - 26\cdot4)^\circ$ was a common response. Some candidates omitted k and stated $\cos a^\circ = 2$ and $\sin a^\circ = -1$ incorrectly at mark 2.

Areas which candidates found demanding

Component 1: question paper — paper 1 (non-calculator)

Question 5: **Vectors**

It was surprising that few candidates were able to deal successfully with ratio in this question. In 5(a), some candidates correctly stated $\overrightarrow{AB} = 4\overrightarrow{BC}$, but interpreted the ratio incorrectly as $1:4$. The reasoning required in 5(b) meant few candidates were able to gain mark 2.

Question 9(b): **Vector pathways**

Despite most candidates answering 9(a) correctly, few were able to identify the correct pathway in (b). Most candidates did not state a pathway in terms of directed line segments at mark 2. $-\frac{1}{2}\mathbf{t} + \mathbf{v} - \mathbf{u}$ was a common response.

Question 11(a): **Sketching a function after a combination of transformations**

There was a disappointing response to this question. Many candidates reflected the graph in the y-axis or the line $y = x$. Candidates who identified the transformations correctly were often unable to produce a sketch with a sufficient degree of accuracy.

Question 12(b): **Magnitude of vector**

Most candidates understood the strategy required for this part of the question. However, few candidates were able to process the values of p successfully. Common errors were:

- interpreting $(p+4)^2$ as $p^2 + 16$
- $\sqrt{p^2 + 8p + 61} = 7 \Rightarrow p^2 + 8p + 54 = 0$

Question 14: **Calculate the definite integral**

Although most candidates attempted this question, many solutions were poorly set out and contained basic algebraic errors and numerical inaccuracies. Errors included:

- Integrand not expressed in integrable form correctly at mark 1.
- Failure to deal with the coefficient of x at mark 3.
- Missing or incorrect use of brackets at mark 4.
- Final answer not simplified, for example $\frac{9}{2} - \frac{3}{2} = \frac{6}{2}$.

Question 15: **Sketching a function**

Many candidates did not sketch a cubic function in response to this question. Most candidates who produced a sketch gained marks 1 and 2, but few were able to interpret bullet point 4 to identify the correct orientation of the graph.

Component 2: question paper — paper 2

Question 4: **Completing the square**

Although many candidates gained marks 1 and 2, fewer candidates were able to deal with the constant term successfully. Working did not always follow logically from one line to the next. There was a lack of rigour in the use of brackets. A common response was:

$$-3(x+1)^2 - 1 + 7$$
$$= -3(x+1)^2 + 3 + 7$$
$$= -3(x+1)^2 + 10$$

Question 8(b): **Minimum value of a trigonometric function**

Although most candidates tackled question 8(a) successfully, few had an understanding of what was required in 8(b)(i) and 8(b)(ii). Some candidates identified the minimum value in 8(b)(i), but were unable to identify the value of x for which this occurred, or failed to deal with the domain properly in 8(b)(ii). Successful candidates often employed a sketch of the function to help determine the minimum.

Question 9: **Optimisation**

Although most candidates attempted this question, many solutions were poorly set out and contained basic algebraic errors. Errors included:

- Failure to express the function in differentiable form correctly.
- Differentiation carried out over ‘two lines’ of working.
- Failure to recognise that the function was discontinuous at $x = 0$.
- Inconsistent labelling in nature table, for example $\frac{dy}{dx}$ instead of $\frac{dP}{dx}$.
- Interpreting $x = 8$ as minimum value of P.

Question 10: **Quadratic inequality**

Most candidates gained 2 or 3 marks for this question. However, few candidates were able to employ a correct strategy (sketch or table of values) to justify their solution for mark 4.

Question 11: **Exponential equation**

Many candidates were unsure of the correct strategies to use to solve exponential equations. Manipulating the equation and applying the laws of logs led to many inventive, but mathematically incorrect, solutions.

Question 12: **Circles**

In question 12(a)(ii) many candidates were unable to show that $c = -455$. Where this mark was awarded, many candidates chose a less efficient method than substitution of coordinates. In 12(b), many candidates were unable to deal with the ratio successfully. A common error was to interpret this as $5:2$. Few candidates used a sketch to aid working. In 12(c), few candidates were able to interpret ‘C_2 touches C_3 internally’ correctly to determine the radius.

Section 3: advice for the preparation of future candidates

Components 1 and 2: question papers — non-calculator and calculator

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.

The following advice may help prepare future candidates for the demands of the Higher question papers:

- In the non-calculator paper, candidates made a significant number of numerical inaccuracies in their working. This costs valuable marks. Teachers and lecturers should consider how best to maintain and practise non-calculator mathematical skills when preparing candidates for the course assessment.
- Teachers and lecturers should encourage candidates to correctly use notation throughout the course, for example vector notation and integral notation.
- Teachers and lecturers should consider how best to consolidate the algebraic skills introduced at National 5, including working with surds and indices and completing the square.
- Teachers and lecturers should encourage candidates to use brackets appropriately throughout the course. In particular, when completing the square and when substituting negative numbers into formulae.
- Vector pathways continue to cause candidates difficulty, and teachers and lecturers should consider how best to extend this knowledge from National 5 to Higher. They should encourage candidates to first identify a pathway in terms of directed line segments, where appropriate.
- Teachers and lecturers should encourage candidates to show clear and rigorous communication in their solutions. Each line of working should follow logically from the line above.
- Teachers and lecturers should encourage candidates to employ sketches, where appropriate, when trying to determine a solution.
- Teachers and lecturers should consider how best to tackle problem solving, which candidates require to access non-routine parts of questions.
- SQA’s website contains the marking instructions for the 2018 course assessment (as well as those from previous years). All those teaching Higher Mathematics, and candidates undertaking the course, will find further advice and guidance in these detailed marking instructions.

Grade boundary and statistical information:

Statistical information: update on courses

Number of resulted entries in 2017	18861

Number of resulted entries in 2018	18753

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	33.5%	33.5%	6282	95
B	21.7%	55.2%	4062	78
C	19.4%	74.5%	3629	62
D	7.7%	82.2%	1442	54
No award	17.8%	-	3338	-

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 which allow a competent candidate to score a minimum of 50% of the available marks (the notional C boundary) and 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 Business Manager and Statistician to discuss the evidence and make decisions. The meetings are chaired by members of the management team at SQA.

- The grade boundaries can be adjusted downwards if there is evidence that the exam is more challenging than usual, allowing the pass rate to be unaffected by this circumstance.
- The grade boundaries can be adjusted upwards if there is evidence that the exam is less challenging than usual, allowing the pass rate to be unaffected by this circumstance.
- Where standards are comparable to previous years, similar grade boundaries are maintained.

Grade boundaries from exam 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 exams set by centres. If SQA alters a boundary, this does not mean that centres should necessarily alter their boundary in the corresponding practice exam paper.