A LEVEL
MATHEMATICS

7357/1 Paper 1
Report on the Examination

7357
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General Introduction to the November Series

This has been an unusual exam series in many ways. Entry patterns have been very different from those normally seen in the summer, and students had a very different experience in preparation for these exams. It is therefore more difficult to make meaningful comparisons between the range of student responses seen in this series and those seen in a normal summer series. The smaller entry also means that there is less evidence available for examiners to comment on.

In this report, senior examiners will summarise the performance of students in this series in a way that is as helpful as possible to teachers preparing future cohorts while taking into account the unusual circumstances and limited evidence available.

Overview of Entry

The paper had a mixed response. Given the circumstances it was not surprising to find unanswered parts of questions on some students' scripts. Other parts indicated a fragmentation of knowledge and application. However, this was considered by the mark scheme being revised and awarding taking note of the generosity given in the summer series.
It was, however, pleasing to find a significant number of questions being attempted throughout the paper covering all aspects of the specification. Algebraic skills were often sound and it was notable that skills and responses to differentiation, proof, integration and explanation questions had improved since previous series.

Comments on Individual Questions

Q1
Almost 70% of students identified the correct answer. The most common incorrect answer was option 1 suggesting students had divided the wrong way round.

Q2
Almost 70% of students identified the correct answer. The most common incorrect answer was option 1 suggesting students had simply quoted '1' from the printed formula.

Q3
Almost 50% of students identified the correct answer. The most common incorrect answer was option 4 suggesting students understood that there must have been an asymptote but chose the wrong function.

Q4
This question had mixed success with part (a) proving more difficult than part (b). More than half of students scored no marks for part (a). This was because they sketched a V-shaped graph rather than the inverted V shape required. Of the students who did sketch an inverted V-shaped graph, marks were then lost for one of two reasons:

- It did not appear in the correct three quadrants
- At least one intersection point with the axes was incorrectly labelled

In part (b) most students scored at least one mark for correctly removing the modulus sign on at least one occasion. However, errors in manipulation prevented many from scoring the second mark.

Q5
This was a very successful question. The intention was to test proof by exhaustion and many students approached it in this manner. However, a common error was to think that 3^0 was 3 and not 1. Of those who did evaluate the powers correctly, some of them lost the final mark for not ending with a fully correct concluding statement, often missing the word ‘integer’ or short cutting the statement they had been asked to prove. A small number of students attempted to use logs but they were rarely successful. Proof by contradiction was very rare, although the attempts seen did score full marks.

Q6
This was a question with diminishing returns. The first part (a)(i) was answered very well and students clearly understand the necessity of a constant with indefinite integrals. Part (a)(ii) was slightly less successful as students needed to refer explicitly to the appearance of the ‘k’. This was done successfully in several ways:

- k is in the wrong place
- The k should have been added not multiplied
- k should be 1
- k ln$x$ should ln kx

Part (b) was much less successful as students needed to explain two key points: demonstrating the appropriate law of logarithms and then concluding that, to be equivalent, c = ln A. Too often students wrote a very general statement saying they were equivalent, when they needed to demonstrate their equivalence.

Q7
This was a very successful question where students demonstrated their knowledge of recurrence relations. As expected 7(b) was more challenging, but there was still a significant proportion of correct answers.

Q8
This question proved to be very challenging, with many students scoring poorly on all three sections. For 8(a) several students seemed to realise they had to use ‘-1’ but then substituted that value directly inside the sine in the formula. Some used a trial and error approach, but could not get the value required. Part 8(b) was more successful in that students could often score the first mark for writing down a correct equation or inequality. However, the second mark required that at least two solutions were found, whilst many found only one. Part 8(c) proved a step too far for almost all students. Many made general comments about Spain rather than identifying the effect of the refinement. It was essential to comment that the refinement would stretch the curve vertically or that it would result in higher maxima and lower minima. In the latter case, a few students mentioned one or the other – not both. The second mark was for making a comparison and then explaining that the new graph did not result in such a stretch and hence would not be appropriate.

Q9
This was a more successful question in that students could show their competent algebraic skills. However, 9(a)(i) was the least successful part. This was because students failed to understand that a counter example involves substituting a value to disprove the statement. A significant number performed algebraic manipulation and scored no marks for this part. Identifying the correct error in 9(a)(ii) was done by about 60% of students. Of those who failed to score this mark some were just not clear enough in their explanation, for example by saying ‘she has missed a term’ or ‘there should have been a repeated factor’. In such questions it is better to be explicit and write down exactly what is missing. In the last part 9(b), just over 40% of students scored full marks.

Student knowledge of the correct structure for partial fractions was good as was the initial manipulation to compare numerators. However, marks were lost for simple slips involving substituting numbers or making mistakes when comparing coefficients. It was disappointing to find that a handful of students repeated the erroneous solution in (a) that had been identified as incorrect.

Q10
This question had mixed success. Part (a) was largely done well – especially (a)(i) and (a)(ii). However, the key error in (a)(iii) was to state that the number of terms = 20 – 5 = 15 rather than 20 – 4 = 16, because the first four positive integers are not used. This part was set to help students in part (b)(i).
The rest of the question proved very challenging with around 20% of students scoring full marks on (b)(i) and 10% scoring full marks on (b)(ii). Although students were aware of the formulae to be used, success relied on the correct identification of the first term, the common difference and number of terms/last term. Many students were only able to identify one or two of these correctly and hence could not then fully succeed. The issue was clearly failing to understand sigma notation and unravelling it by substituting the values. If more students had started by doing this the success rate would have been much higher. In part (b)(ii) a significant number of students mixed up the nth term and sum to n terms formula. This was one question were the initial mark scheme was revised significantly to reward students who had at least made some progress by identifying one of the key values/expressions correctly.

Q11
The response to this question was very disappointing. Part 11(a) was meant to be a straightforward starter to ensure students could find the area of a trapezium correctly. Problems occurred as students seemed to race into using several ordinates/strips rather than the one trapezium they had been asked to use.
In 11(b) a significant number of students made at least one of the errors listed below:
- Confused strips with ordinates
- Substituted incorrectly into the trapezium rule formula because they omittedbrackets
- Ignored the request for the trapezium rule and used their calculator to find the integral exactly
- Only found the volume of one piece
- Divided by the density instead of multiplying
- Did not give the final answer to the nearest gram.

Around a third of students scored no marks on this question with just over 10% scoring all five.
Part 11(c)(i) was more successful than 11(c)(ii) as it was more routine and well-rehearsed responses were common. However, all that was needed for the latter mark was to comment on the rounding that had occurred.

Q12
This was one of the more successful questions on the paper with students scoring more confidently throughout.
Many knew how to approach part (a), but sometimes failed to score the second mark as the exact values for the trigonometric ratios had not been evaluated. When a question states 'Show that...' students are required to clearly show enough steps to be convincing in their argument.
Part 12(b)(i) was done well, which was a significant improvement on the past. Students could show their skill with implicit differentiation, standard trigonometric derivatives and the product rule. Manipulation skills were good.
Part 12 (b)(ii) was again done well, although some students must have used their calculator incorrectly as the substitution was seen to be correct, but the evaluation was not.

Part 12 (b)(iii) was more mixed, largely because a significant number of students found the equation of the normal rather than that of the tangent, perhaps expecting the normal to be asked for. Of those who did find the equation of the tangent some lost the final mark due to poor manipulation or for not giving an exact answer.

Q13

In part (a)(i) more than half of students could correctly find the algebraic expression for the inverse function, however, most did not state the domain and so lost the final mark. Around 75% of students correctly obtained an expression for ff(x) which on this occasion did not have to be fully simplified.

Part 13 (b)(i) proved very challenging. Around 60% of students scored the first mark for either identifying the correct maximum value or minimum point. However, two incorrect answers that often then followed were:

- $0 \leq y \leq 6$
- $-1.5625 \leq y \leq \infty$

On this occasion, it was decided that the final mark would only be given to correct finite set notation – as such just 1% of students achieved the final mark. However, previously mentioned errors were more costly.

The response to (b)(ii) was poor. This was because of a misunderstanding about one-to-one, many-to-one and one-to-many mappings. It was clear that some students were randomly guessing about the nature of the functions involved. The second mark could only be scored if there was some demonstration of the function being many-to-one.

Part (c) was much better, with around a third of students scoring the two method marks showing their algebraic skills with composite functions and expanding quadratics. Manipulating to get the correct denominator of $2(x-2)^2$ proved most discriminating.

Part (d) was done better than expected with students able to set the denominator equal to 0 and to solve the resulting quadratic. On many occasions, the final mark was lost as no justification was made for the value chosen – relating back to the domain in question.

Q14

Part (a) was more successful than in the past, but again the final mark was often lost for not explicitly comparing their values to 0 or for not writing a concluding statement.

Part (b)(i) was done well with many students applying the correct derivative rules. However, a significant number did not know the derivative of 3^x. Quite often the last mark was lost due to incorrect algebraic manipulation.

Part (b)(ii) was not done as well as expected with some students not being able to form a correct Newton-Raphson expression or evaluating it incorrectly.

Part (b) (iii) was the most challenging on the paper with only a very small proportion able to score 1 mark. Too many focused on saying ‘the denominator would be 0’ – however if you ‘tidy up’ the fraction it would be seen that this is not the case. It was hoped that students would attempt the evaluation and then see the sequence 0 , 0 , 0, ……and thus deduce that the tangent is vertical at this point.

Q15

Many students knew how to find areas by integration successfully but did not find the correct point of intersection for the upper limit. However, the question did differentiate well with students often scoring around half marks for showing their skills of integration. Solving an exponential equation of this type (a quadratic in disguise) was too challenging for many students. Too often ‘In’ was simply put in front of each term and the powers then brought down. Students who squared both sides were often more successful in spotting the ‘hidden quadratic’. Substitution of limits into integrals was generally good and clear.

Concluding Remarks

This paper was generally of lower demand than Paper 1 in the 2019 series. It was pleasing to see students completing the paper and, although the final question was challenging it was also accessible and students could score marks either for integration or attempting to find the intersection of the curves.

Students showed good awareness of a range of algebraic techniques, such as in question 13 and implicit differentiation in question 12.

Students would benefit from more practice in giving precise answers to questions which ask “Explain…” so that their answers address the question. It can be beneficial to echo the wording of the question when writing answers, as is expected in the concluding statement of a “Show that…” or “Prove…” question.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.