A Level

Further Mathematics

7367/2

Report on the examination

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General

The demands of the paper were similar to last year, and students showed a similar level of performance. The mean mark increased by about 1.5%. There was quite a lot of integration on the paper; most of this was done very competently, with the possible exception of Question 16, which required use of an inverse sine function.

In general, questions which were similar to questions from previous years were answered well. Questions 9 and 13 were structured in an unfamiliar way, and students found these more difficult.

It was encouraging again to see that very few question parts were not attempted.

Question 1

Rather surprisingly, students scored worse on this question than on the other multiple-choice questions. This may have been due to confusion around plus and minus signs. In any event, over 80% got this right.

Question 2

Answered correctly by over 90%

Question 3

Answered correctly by over 90%

Question 4

Answered correctly by over 90%

Question 5

Done very well; over 95% gained both marks.

Question 6

An unfamiliar approach to Euler’s formula which was handled well, with around two-thirds gaining full marks. Some dropped a mark by substituting 2.1 instead of 2

Question 7

Nearly 80% got full marks here. Some attempted to find the inverse of matrix **A** and could not make progress.

Several students seemed to take longer than necessary to reach a solution, but most got there in the end.

Question 8

Part (a) was attempted by nearly all students, and over 90% gained 2 or 3 marks.

The most common error was to make their graphs higher on the left and lower on the right than the original graph. Also, a few students had the axis intercepts inside the original ones instead of outside.

Part (b) was nearly always done correctly by those whose graph was mostly accurate. A few gave a non-strict inequality and so only gained one mark.

Question 9

Around half the students gained full marks for part (a). However, many others used an incorrect method, which assumed that z was real. Because of this they were not able to gain any marks even if their answer was correct.

A quarter of students answered part (b) completely correctly, nearly all using the method shown on the mark scheme. Those who formed and solved a quadratic equation then often simply stated that their solutions were equivalent to the required answers, without showing any working. This meant that they only gained two marks.

In part (c), nearly half were awarded the first mark for obtaining the correct answer, but only a small number justified their answer with reference to parts (a) and (b).

Question 10

Nearly 90% gained full marks in part (a). Those who didn't often made sign errors.

Part (b) was a familiar task for many students, and around 70% gained 3 or 4 marks. However, only about 25% gained the final mark, mainly because they were required to state "the range is…" rather than simply writing the inequality.

In part (c), it was not sufficient to simply state the correct answer, as it could have been found using calculus. Nearly 30% scored no marks, with most of the remainder gaining full marks.

There was a wide range of marks in part (d), with a roughly even division between 1, 2, 3 and 4 marks. Those who scored only one mark often only drew the right-hand branch. Some students missed out one or more of the axis intercepts. Most students showed the graph approaching the asymptotes, but when this was drawn very inaccurately, with the graph first approaching then moving away from the asymptote, the final mark was not awarded.

Question 11

Most students made some progress on part (a), with around 50% scoring full marks. The method shown on the mark scheme was the most popular, and students who used this method usually got full marks, or 4 marks if they made a calculation error. Those who found and expression for the magnitude of vector *AP* were also able to gain full marks.

Part (b) was done very well, especially by students who used the vector product as shown in the mark scheme. Those who attempted to solve it by first finding a vector equation of the plane with two parameters often struggled to reach a correct answer.

Part (c) was also answered well, with around 80% gaining 2 or 3 marks. Those whose answer to part (b) was incorrect were still able to gain the two method marks.

Question 12

This standard integration question was done well, with over three-quarters of students gaining 4 or 5 marks. Those who correctly completed the square nearly always went on to a complete solution.

Some made the substitution $\cos\theta = \frac{x+3}{2}$, generally leading to a correct solution. However, they could have saved time by using one of the results in the formulae booklet.

A few students tried to use partial fractions, not appreciating that the square root made this an incorrect method.

Question 13

Nearly 80% gained full marks in part (a).

The instruction to "verify", which appears in part (b), is not something students are often required to do, and some misunderstood what was needed here. Some gave a general explanation of how the given complex number multiplication represented a rotation and an enlargement, which was not acceptable. Others included complex numbers in matrix calculations. Nevertheless, around 25% scored full marks.

Part (c) was found difficult, with about 20% gaining full marks. Students were expected to use complex numbers in their solution. Those who did this often obtained and solved simultaneous equations in x and y, rather than following the method on the mark scheme.

Students were also given credit if they used the transformations identified in part (a) to solve part (c). Using the calculator to find $\mathbf{M}^8$ was an unacceptable method.

Question 14

80% of students gained both marks in part (a), with nearly all the rest gaining 1 mark, usually because the pole was near the centre of their drawing.

In part (b), some students lost marks because they did not follow the instruction “Fully justify your answer”. When this is included in a question all steps must be shown; in particular, it is not sufficient to integrate using a calculator.

In general, the use of trigonometric identities to perform integration was done very well. However, in some cases the coefficients of the trigonometric expressions were incorrect. This meant that even if a student obtained the right answer, they could lose marks for incorrect working.

Some students lost a mark for not including units.

Question 15

This was done very well, with two-thirds gaining 5 or 6 marks. Many students lost the final mark because we required working as shown in the final marking instruction on the mark scheme. Others, for example, omitted equals signs in their proof.

When we use the word “prove” in the question we are expecting a “rigorous argument”; that is, all details need to be correct.

The use of l’Hôpital’s rule was allowed as long as it was fully justified; that is to say, they explained that both the numerator and denominator tend to infinity.

Question 16

This was not done well, with nearly half of all students scoring one or zero marks. To reinforce the point made regarding Question 14(b), if students wrote just the integral and the answer, they could gain only one mark, as they are being asked to “Fully justify…”

It was somewhat surprising that this question was not answered more successfully, as it is quite similar to Question 12, which was answered well. For some students the presence of π in the given answer may have led them to use a formula for surface area of revolution, or volume of revolution. Others integrated the expression for y^2 without taking the square root.

Question 17

Around 40% of students gained full marks in part (a). A further 25% scored two marks. In many cases this was because they used the initial value $\frac{\mathrm{d}y}{\mathrm{d}t} = 0.8$ instead of – 0.8

This does not lead to the given result, so some students who had started with this incorrect value went back over their work adjusting minus signs; however, all too often they did not do this thoroughly enough.

Part (b) was done well, with nearly half of all students gaining 6 or 7 marks. Most used the integrating factor method, as shown on the mark scheme. The use of a particular integral and complementary function also leads to a quick solution.

In part (c) about 30% gained full marks. A common error was to start with $u - y = 28$

In part (d) we only accepted answers similar to the one given on the mark scheme. In a few cases students gave more than one limitation. They should be aware that this is not a good idea, since, after being asked for one limitation, they will only get the mark if both limitations are correct.

Mark Ranges and Award of Grades

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