AQA
Questions matter

A-level
Further Mathematics

7367/2 Paper 2

Report on the Examination

7367
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General

Students performed better than they did in 2023. The mean mark was about 7 marks higher than last year. There was a wide range of marks, with every score from 2 to 98 represented.

As in previous years, most students attempted all, or nearly all, question parts. Many students showed excellent technique in gaining high marks for questions 9 (Euler's method and midpoint formula), 14a (inverse matrix), 15b (inequality) and 19 (differential equation).

Students found the following questions more difficult: 17b (especially part b(ii)), 18 and 20a. Questions 18 and 20a were expected to be challenging; in question 17b(ii), techniques which had previously been effective in answering similar questions did not work so well in this case.

Nearly all students attempted at least the first part of question 20, showing that shortage of time was not an issue for most students.

Question 1

Over 95% answered this correctly.

Question 2

Around three-quarters of students answered this correctly.

Question 3

Around 85% answered this correctly.

Question 4

Nearly 90% of students answered this question correctly.

Question 5

Fewer than three-quarters of students answered part (a) correctly. Some gave the incorrect $\sum_{r=1}^{n} n(n+1)$ or similar.

Around three-quarters of students gained full marks in part (b), but some gave themselves extra work to do by multiplying out brackets and working with fractional terms, rather than identifying common factors at an early stage.

Question 6

This was done well, with nearly 90% of students gaining 2 or 3 marks. Both of the standard methods — the one in the mark scheme, and using the sum, product and paired sum of the roots — were used effectively.

Some students lost the final mark by giving fractional coefficients, or omitting '= 0', so that their answer was an expression, rather than an equation.

Question 7

Nearly all students started well by obtaining the matrix products **AB** and **BA**, although a few gave $(p-1)(2p-1)$ instead of $(p-1)+(2p-1)$ as the top right element of **BA**. Over 80% then went on to form and solve a quadratic equation.

In order to gain the final mark, students needed to explicitly state '**A** and **B** are commutative, so **AB** = **BA**.' Only 30% did this, so most students only scored 3 marks.

Question 8

This was an unfamiliar type of question, and there was a wide range of marks. Over 60% used the distributive property of the cross-product, with most also using $\mathbf{a} \times \mathbf{a} = \mathbf{0}$. Most of those who used the anti-commutative property went on to score full marks; however, some students mistakenly thought that the cross-product was commutative.

Those who attempted to obtain the components of the vectors generally made little or no progress.

Question 9

This was done well, with over 60% of students gaining full marks. Students are adept at applying Euler's method and the midpoint formula.

Most students showed their substitutions of the required numbers into the respective formulae. This is good practice, as it ensures that method marks are awarded even if there is a calculation error.

Question 10

There was a wide range of marks here, with around a quarter of students gaining full marks, and a mean mark of around 55%.

Some incorrectly used the variables x and y on both sides of their matrix equation. This would be the correct method for finding a line of invariant points, but not for an invariant line. Others used $y = mx + c$ and were only able to gain full marks if they later stated and used the fact that $c = 0$.

Students who used the method for finding an eigenvector were able to gain full marks if they explained that this was equivalent to finding an invariant line through the origin.

Question 11

Students engaged well with this question, with a range of thoughtful answers. Nearly all remembered to include the concluding statement 'Sam is right' (or equivalent, eg 'Latifa is wrong.')

Most used an explanation involving real polynomials of odd degree, and pairs of complex conjugate roots. Those who wrote 'imaginary roots' were not able to gain the final mark.

A few students did not notice the ‘no repeated roots’ condition in the question, and incorrectly suggested polynomials of even degree as meeting the condition.

Question 12

This question was answered well, with nearly half the students gaining full marks. Most students set up simultaneous equations, as shown in the typical solution on the mark scheme, but some used inverse matrices successfully. In both cases, students made good use of their calculator functions.

A few students did not manage to use the result given in the formulae booklet to obtain the matrix **N**. Others applied the matrices in the wrong order. However, it was possible for students to pick up some method marks in spite of these errors.

Question 13

Using the method of differences with three-part terms proved challenging in part (a), with under 40% gaining 4 or 5 marks. Over 80% obtained a correct expression in partial fractions, but some made their next stage more difficult by not listing the fractions in the order given in the mark scheme. This made deleting the appropriate fractions more awkward.

It is always worth students checking that their partial fractions are correct, because if there is, for example, a sign error, then the method of differences will not work.

A few students went straight from their method of differences array to the given answer with no intermediate working and lost the last mark. Where the answer is given, it is necessary to show all steps in the working. Others lost the last mark because they did not have anything on the left-hand side of their equation.

In part (b), most students were able to arrive at a quadratic equation or inequality. However, some went by a rather indirect route, giving them more chances to go wrong. It is a good idea to look out for opportunities to simplify early on, as shown in the typical solution.

Question 14

Part (a) was done well, with nearly two-thirds of students gaining full marks. This is an area where students are very well prepared. As expected, nearly all gained the mark in part (b).

In part (c), most students applied the correct method, with 70% gaining 3 or 4 marks. Some dropped the final mark for not stating ‘which is independent of k’ or equivalent.

Question 15

In part (a), over 90% gained 2 or 3 marks. Some omitted to show the value of 4 where the curve meets the x-axis.

Part (b) was done very well, with nearly two-thirds of students gaining full marks. Most used the suggested method of solving two separate quadratic inequalities. Those who squared both sides of the inequality to obtain a quartic were able to arrive at the correct solution, but it should be noted that this method will not give a correct solution in all circumstances.

A few students incorrectly used the symbol for intersection instead of union when giving their answer in set notation, although this was not required.

Question 16

Nearly all students answered part (a) correctly.

In part (b), some students forgot to square the expression before integrating; others multiplied by 2π instead of π, or omitted π altogether. Students were expected to use their calculator to obtain the answers to parts (b)(i) and (b)(ii) (This is implied by the instruction to give the answer to three significant figures.) Some did not realise this and attempted to use an analytical method. On rare occasions this was successful, but in most cases, it did not lead to a correct answer.

Question 17

Students generally found this to be a challenging question.

Part (a) was done well, although a few students gave the answer $a = 4$

About 40% of students gained no marks in part (b)(i), meaning that they were not able to identify the point represented by z_1. Of those who did make progress, some used Pythagoras twice, and were able to obtain the answer quickly. Others adopted an approach using coordinate geometry, which turned out to be a much lengthier method.

Most students struggled to make progress in part (b)(ii), with under 10% obtaining more than 1 mark. Hardly anyone used the method given in the mark scheme. Some students used their calculator to show that the sine of the angle they had found was equal to the required value. Unfortunately, because the question asked them to 'show that…' and included an exact value, calculator methods were not acceptable.

As it turned out, those that successfully used a coordinate geometry method in part (b)(i) were better placed to use their intermediate results to answer part (b)(ii).

Question 18

This was expected to be a challenging question. Two-thirds of students gained marks here, and 20% scored full marks.

A typical mistake was to use an index of 4 instead of –4 in the binomial series. This then made it difficult to express the answer as a power series.

Question 19

Students were very well prepared to solve this type of differential equation, with over half obtaining 7 or more marks.

One common error was to omit the constant term from the particular integral. Another was to include in the particular integral a term in e^{5x} instead of $x\mathrm{e}^{5x}$. It was encouraging to see that several students, having found out that the incorrect option did not work, then used the correct one.

The way that the mark scheme was structured meant that even if students made these errors, they were able to get credit for the steps that they carried out correctly.

Question 20

Some students may not have been expecting a question of this type. Around two-thirds used integration by parts to gain the first mark in part (a), and about half obtained one or more further marks. A common error was to omit a minus sign when differentiating. There were also some errors in notation, such as omitting the brackets when multiplying an integral by $(n + 1)$.

It was encouraging to see that, despite the demands of the question, nearly a quarter of students gained full marks in part (a).

Part (b) was done well, with over half obtaining 2 or 3 marks.

Mark Ranges and Award of Grades

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