



A-LEVEL

FURTHER MATHEMATICS

7367/1 Paper 1
Report on the Examination

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General

The paper had questions on a wide variety of topics within the Further Mathematics specification, which allowed students to show their skills across many different areas of mathematics.

Question 1

Nearly all students remembered the form of the SHM equation and the formula for the period of its motion to get the correct answer.

Question 2

Students scored well on this question, with good evidence of a variety of approaches.

Question 3

With the formulae booklet having the derivative of $\sec x$ in it, virtually all students knew to choose either the first or second answer. The majority then remembered that there is a sign difference between the derivatives of $\cos x$ and $\cosh x$, hence choosing the correct answer.

Question 4

The great majority of students got this simple eigenvector question correct.

Question 5

In part (a) students generally took one of two approaches. The most popular approach was to use the complex conjugate to create a quadratic factor, then factorise out the second quadratic factor, hence getting the other two roots. Marks were generally lost due to arithmetic slips and a very few students assumed that the third and fourth roots would also have to occur as a complex conjugate pair. The second method was to substitute the given root into the equation to obtain the value of k , and then to solve the equation to get the roots. It was good to see efficient use of a calculator in this approach.

Surprisingly, some students who scored full marks in part (a) dropped marks in part (b). Those who obtained any two real solutions in part (a) were able to score in part (b) and many did so.

Question 6

In part (a) students were better prepared for proving the formula for the logarithmic form of an inverse hyperbolic function than in previous years. Virtually all students were able to gain something by remembering the exponential definition of $\tanh x$. Of those who worked through to the end, some left their answer as $y = \dots$ rather than $\tanh^{-1} x = \dots$ forgetting that this is not

appropriate in a proof question. A few others, who used the quadratic equation formula, forgot to justify rejecting the negative root.

In part (b) more students used an appropriate hyperbolic identity than substituted in the exponential form. Those using the hyperbolic identity approach generally did better. Most students sensibly used a calculator to solve the resultant quadratic equation.

Question 7

In part (a)(i) it was great to see students getting better at finding the inverse of a matrix. Most students knew what they needed to do, and, barring the odd slip, were generally successful. Some students made their work almost illegible by writing each 3×3 matrix on a single line and they would be well advised to use two or three lines.

In part (b) it is important to remember that when instructed to ‘use your answer from part (a)(i)’ students must clearly demonstrate that they have done this, and not just put the given equations into the calculator to obtain a solution.

Question 8

Well over a half of students successfully found the required equation in part (a), with a few others making some progress.

In part (b) just under a half of students gave a fully correct solution. Some students put the centre of the circle or the end of the half-line at the wrong point, having made a sign error. Students are advised to use compasses to draw circles: in this question the required region was sometimes not clearly drawn because the sketch was inaccurate.

Only about an eighth of students scored both marks in each of (c)(i) and (c)(ii). Those who were successful used the hint from part (a) that an algebraic approach was the best way forward. Many students incorrectly found the point on the circle closest to the origin, or the distance between the points of intersection of the line and the circle rather than the closest point in the region which was at the intersection of the perpendicular from the origin to the line from part (a).

Question 9

This was a synoptic question covering the topics of polar equations and matrix transformations. Part (a) was a straightforward curve-sketching task that was done well by most students. Part (b) proved trickier than expected. Students are reminded that to ‘explain what Roberto has done wrong’ they need to criticise what has been done wrong and explain why it is wrong, hence the two marks. Students are also reminded that a statement of fact is not a criticism. For instance, ‘Roberto has integrated from $-\pi$ to π ’ is a statement of fact and gains no credit, whereas ‘Roberto should not have integrated from $-\pi$ to π ’ is a criticism and gains credit.

Parts (c) and (d) proved to be straightforward for most students.

Part (e)(i) proved too hard for some students as it involved the understanding that the polar coordinates of P had to be changed into Cartesian coordinates before the matrix transformation

could be applied. The Cartesian coordinates of P' then had to be changed back into polar coordinates.

Part (e)(ii) was then often left blank when both marks were available to all students even if part (e)(i) had not been attempted.

Question 10

In part (a) most students obtained the correct value of $\cos \theta$ and went on to set up the correct scalar product equation. Those who attempted to use the vector product were generally unsuccessful because they formed an equation with a vector equal to a scalar. However, even those who struggled with the question were able to score marks. Some students fell at the final hurdle by forgetting to write down both solutions to the quadratic thus making it clear that they had selected the integer value of p .

Three-quarters of students did not score a mark in part (b), suggesting students need more practice in finding the distance between two planes.

Likewise, in part (c), two-thirds of students did not score a mark, suggesting that more practice is needed in determining the image of a point in a plane.

Question 11

This type of question continues to be a challenge for most students. The setting up of a second order differential equation by considering the general force equation, as in part (a), is a challenging task.

In part (b)(i) students who found part (a) too challenging were able to access all the marks. However, most students forgot that they had to consider the mass and started with $\lambda^2 + k\lambda + 50 = 0$, which leads to $k = 10\sqrt{2}$. Realising something was amiss a few students identified their error and re-did the question correctly.

Students who got $k = 10\sqrt{2}$ in part (b)(i) could still score full marks in part (b)(ii) as long as they consistently continued with this value of k , as they would start off from $\lambda^2 + 10\sqrt{2}\lambda + 50 = 0$.

Even those who understandably started from the incorrect $\lambda^2 + \frac{16\sqrt{2}}{5}\lambda + 50 = 0$ were able to score very well in both this part and part (b)(iii). A few students decided to drastically simplify the question by only considering the SHM equation $\ddot{x} + 50x = 0$ and gained very little credit.

In part (b)(iii), even though students could gain credit by using their answer to part (b)(ii), most left it blank or were not sure how to proceed.

Question 12

There were many good responses to parts (a) and (b) in this question. Part (a) is a standard n th roots of unity question, which was done very well.

The only students who gained no credit in part (b) were those who **stated that** the points formed a regular pentagon, rather than **explaining why** the points formed a regular pentagon.

Part (c) required students to expand their expression for z^5 using the binomial theorem and then simplify. This is a standard technique with various uses across the complex-number topic area, but it is possible that students in this series had reduced exposure to it because some aspects of the wider topic, such as de Moivre's theorem, were not being tested and so did not appear in the Advance Information. Nevertheless, over half the students knew how to get started and most of them went on to score high marks for this part. Some dropped marks though due to algebraic slips.

Parts (d) and (e) were very challenging, with three-quarters and two-thirds of students respectively not gaining a mark. Students did not typically make the links with the previous parts of the question.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the [Results Statistics](#) page of the AQA Website.