Qualification Accredited

Oxford Cambridge and RSA

A LEVEL

Examiners' report

FURTHER MATHEMATICS A

H245

For first teaching in 2017

Y540/01 Autumn 2020 series

Version 1

ocr.org.uk/maths

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

i	Reports for the Autumn 2020 series will provide a broad commentary about candidate performance, with the aim for them to be useful future teaching tools. As an exception for this series they will not contain any questions from the question paper nor examples of candidate answers.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

A full copy of the question paper and the mark scheme can be downloaded from OCR.

Paper Y540 series overview

This paper, along with Y541, assesses the compulsory core content of the new (from 2017) A Level Further Mathematics A – H245 qualification. Questions on either paper can assess any part of the core specification.

This is the second year in which these papers have been sat. However, due to extraordinary circumstances, the paper was sat in October with an extremely small cohort. So, feedback on candidate performance is limited.

Candidates who did well on this paper generally did the following:	***Candidates who did less well on this paper generally did the following:***
• Were familiar with the whole breadth of the specification, and secure in their knowledge of basic techniques and associated key facts.	• Often dropped marks by producing overly complicated or inefficient solutions with increased opportunities for making algebraic errors.

It is hoped that the following comments on each question will help teachers.

Question 1

The majority of candidates knew and could apply the formula for the mean value and scored both marks.

Question 2

A good majority of candidates were able to use the formulae for the sums of cubes, squares and integers and to make good progress to achieve the correct response. Those that took out factors of all three sums found the subsequent algebra straightforward.

However, a significant number of candidates multiplied them all out and collected like terms to obtain a quartic expression. This expression then had to be factorised. A few did not do so and so lost a mark. The remainder required double the amount of work by multiplying out and then factorising with some dropped marks through careless mistakes.

Key point call out
Candidates should be encouraged to look for factors first rather than multiply everything out before looking for factors.

Question 3

In part (a), candidates should have noted the command word 'Find' alongside the single mark allocation which signifies that no working need be seen and that their calculator should be used. Those that squared the matrix A and then squared the result may have lost time.

i	**OCR support**	Candidates should understand the requirements expected where a question uses command words such as 'Find', 'Solve' or 'Calculate'. These command words indicate, while working may be necessary to answer the question, no justification is required and a solution could be obtained from the efficient use of a calculator. The command words are defined in the specification and a student summary guide can be found on the assessment tab of the H245 qualification page on the OCR website. A Level Maths command words poster.

Key point call out

It is expected that candidates for this unit will be conversant with the matrix facilities on their calculator; in this case keying in the 9 cells for matrix A and then finding the 4^{th} power is what was required.

In part (b) that the transformation represented a rotation earned one mark with the other mark being given for a full explanation of what type of rotation it was.

Question 4

In part (a) most candidates were able to write $25\mathrm{i}$ in exponential form but found difficulty in finding the square root. The first root was found easily but unlike real numbers the addition of ± in front of the first root does not give the correct response. A few students did not give their answer for θ in the range stated in the question, $0 \leq \theta < 2\pi$, writing the argument as $-\frac{3\pi}{4}$.

The Argand diagram in part (b) was poorly done. Not only were the two roots expected in the right place but that the modulus of $25\mathrm{i}$ on the *y*-axis needed to be considerably larger than the modulus of each root.

Question 5

Most candidates showed that they knew, and could correctly use, the identity $\cos n\theta = \frac{1}{2}\left(z^n + z^{-n}\right)$.

However, a significant number of worked out $\left(z^2 + z^{-2}\right)^2$ before finding the four terms of $\left(z^2 + z^{-2}\right)^3$, with errors often seen in the algebra. In 'show that' questions, where the answer is given, then marks are awarded for the accuracy of the complete mathematical argument.

Key point call out

For a "show that" question the examiner must be able to see that that candidate has worked the question through to the given conclusion rather than just writing the end point down without adequate working.

Question 6

For this question not only was the formula for the distance required but also the cross product of the directions of the lines and the dot product of two position vectors, one on each line. A significant number of candidates made mistakes in their calculations even when there was evidence that the correct method was known.

Question 7

Many candidates completed this question successfully. However, a significant number of candidates dropped marks with the formal statements required for an inductive proof, either in the initial base case or in the final conclusion.

Question 8

Part (a) was standard but a number of candidates found an identity in exponentials without mentioning $\cosh 2u$ or $\sinh u$.

In part (c) many did not do a complete substitution, ending with an integral in u to be integrated with respect to x. Those that progressed well here, recognising also that the result of part (a) was required, often did not complete the question to give the response in the form stated.

Unless part (c) was correct, the response for part (d) would not take the form given, although a substitution into their response for part (c) gained the method mark.

Question 9

In part (b), rather than using the symmetry of roots, the working for part (c) was seen. So, some extra algebra was needed, creating more opportunities for errors.

Part (d) proved to be a challenging question for most candidates. It was necessary to realise that the only way to find a simple answer for the *n*th power of each complex root was by a conversion to mod/arg form. Those that did realise this usually succeeded in obtaining the required response.

Question 10

The differential equation in part (a) was a statement of Newton's second law. In order to complete the "show that" this had to be stated. Not many candidates did this and some responses lacked the mathematical argument required to justify the given answer.

In part (b) the integrating factor was usually found and an integration by parts performed satisfactorily. There were many steps along the way, however, including the finding of the arbitrary constant of integration. This meant that candidates had to interpret the initial conditions from the stem of the question.

For those who found the correct particular solution the approximation in part (c) was straightforward. Those that had a particular solution that did not include the exponential term might have accepted a clue that something was wrong here.

Part (d) for the refined model was usually answered well but part (e) had very mixed responses.

Question 11

Part (a) requiring the conversion of a cartesian equation to a polar equation was usually well done.

The response to part(b) was identical to part (a) giving the hint for part (c).

Part (e) had two parts. The first mark was for showing that when $r = 0$, θ took the values 0 and $\frac{\pi}{2}$. However, in order for there to be a loop, r had to be positive for all values in the range and this was often missed.

Question 12

Many candidates appreciated that the integrand had to be split into partial fractions in order to perform the integration. The inclusion of $\frac{D}{1+x^2}$ instead of $\frac{Cx+D}{1+x^2}$ was not a correct split and so did not earn the first 3 marks. However, since $C = 0$ the result was the same and so the last 3 marks could be earned.

The result $\frac{4}{1-x^4} = \frac{2}{1+x^2} + \frac{2}{1-x^2}$ was only acceptable in two circumstances.

(i) If $\frac{2}{1-x^2}$ was split further to give $\frac{2}{1-x^2} = \frac{1}{1+x} + \frac{1}{1-x}$ as a further process during integration.

(ii) $\frac{2}{1-x^2}$ was seen to give $\tanh^{-1} x$ when integrated.

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