Qualification Accredited

OCR
Oxford Cambridge and RSA

AS/A LEVEL GCE

Examiners' report

MATHEMATICS

3890-3892, 7890-7892

4725/01 Summer 2018 series

Version 1

www.ocr.org.uk/maths

Introduction 3
Paper 4725/01 series overview 4
Question 1(i) 5
Question 1(ii) 5
Question 2 5
Question 3(i) 5
Question 3(ii) 5
Question 3(iii) 6
Question 4(i) 6
Question 4(ii) 6
Question 5(i) 6
Question 5(ii) 7
Question 6(i) 7
Question 6(ii) 7
Question 7(i) 7
Question 7(ii) 8
Question 8(i) 8
Question 8(ii) 8
Question 8(iii) 8
Question 8(iv) 8
Question 9(i) 9
Question 9(ii) 9
Question 9(iii) 9

Introduction

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

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report. A full copy of the question paper can be downloaded from OCR.

Paper 4725/01 series overview

The number of candidates taking this legacy unit was lower than in previous years, reflecting the fact that this is the first year for examination of the reformed AS Further Mathematics. However, the standard of the solutions was generally of a high standard, with most being able to show a good range of knowledge of the specification content. Completely correct solutions to all questions were seen, with questions 6(ii) and 7(ii) proving to be the most testing. The number of times a candidate made no attempt at a particular part of a question was quite low. The standard of presentation was generally quite good, but on occasions marks were lost by a candidate miscopying their solution to a previous part of the question.

There was no evidence of candidates being under time pressure. It was pleasing to see that more candidates were showing that they had checked their solution, often finding errors that could then be removed.

Question 1(i)

1 The matrices **A**, **B** and **C** are given by $\mathbf{A} = \begin{pmatrix} 5a \\ 2 \end{pmatrix}$, $\mathbf{B} = \begin{pmatrix} 7b \\ -3 \end{pmatrix}$ and $\mathbf{C} = (3 \quad 6)$.

Find

(i) $5\mathbf{A} - 4\mathbf{B}$, **[2]**

This question was generally answered accurately by the majority of candidates, with almost all candidates giving a matrix of the correct order. Marks were lost through simple arithmetic or algebraic errors e. g. 25*a* – 28*b* becoming – 3*b*.

Question 1(ii)

(ii) **BC**. **[2]**

Most candidates found a 2 x 2 matrix, with only minor arithmetic slips. A significant minority multiplied the matrices in the wrong order and obtained a 1 x 1 matrix.

Question 2

2 The complex number w has modulus 6 and argument $\frac{2\pi}{3}$. Find $\frac{\sqrt{3}+2\mathrm{i}}{w}$, giving your answer in the form $x+\mathrm{i}y$, where x and y are exact real numbers. **[5]**

The majority of candidates showed a correct method for finding the real and imaginary parts of *w*, but did not appreciate that *w* lies in the second quadrant, and so made sign errors in either the real or imaginary parts, or both. Most realised that to obtain an answer in the correct form, the complex conjugate of *w* was required and used it correctly, with minor arithmetic errors, usually in the simplification of the numerator, being seen.

Question 3(i)

3 The matrix **D** is given by $\mathbf{D} = \begin{pmatrix} d & 0 \\ 0 & 1 \end{pmatrix}$, where $d \neq 0$.

(i) Find $\mathbf{D}^{-1}$. **[2]**

Most candidates found accurately the inverse matrix. Some omitted to divide by the determinant of **D**, which then caused problems in **(iii)**.

Question 3(ii)

Matrix **D** represents the transformation P.

(ii) Describe fully the transformation P. **[2]**

A stretch was recognised by most candidates, the most common errors being to give the scale factor as 1/*d*, presumably from the inverse matrix, or to give the wrong direction of the stretch.

Question 3(iii)

The transformation T is represented by the matrix $\begin{pmatrix} 0 & 1 \\ -d & 0 \end{pmatrix}$ and is equivalent to the transformation P followed by the transformation Q.

(iii) Find the matrix that represents the transformation Q and describe fully the transformation Q. **[4]**

Using matrix multiplication, with either the answer to **(i)** or a general 2 x 2 matrix, were both seen, often accurately, usually followed by a correct description. Marks were most often lost when the order of the matrix multiplication was incorrect, which then lead to a matrix which was difficult to describe in terms of a single transformation. Some candidates produced a sketch of the unit square and its image and so deduced the transformation Q and then were able to write down the matrix required.

Question 4(i)

4 The loci L_1, L_2 and L_3 are given by $|z-3-4\text{i}|=2$, $\arg(z-3-4\text{i})=\frac{\pi}{3}$ and $|z|=|z-12|$ respectively.

(i) Sketch on a single Argand diagram the loci L_1, L_2 and L_3. **[6]**

Most candidates recognised that L_1 was a circle, but often did not to give a clear indication of the radius. L_2 being a half line was generally done very accurately, with the starting point (3, 4) clearly shown. L_3 was sometimes given as a circle or a horizontal line. Many sketches were clear and accurate and so many candidates did get full marks.

Question 4(ii)

(ii) Indicate, by shading, the region of the Argand diagram for which

$$|z-3-4\text{i}|\geqslant 2,\ 0\leqslant \arg(z-3-4\text{i})\leqslant \frac{\pi}{3} \text{ and } |z|\leqslant|z-12|. \quad \textbf{[3]}$$

The region defined by the given inequalities was generally shown correctly. A common error was to shade to the right of L_3 and the necessity for a horizontal line from (3, 4) for L_2 was sometimes missed. A few candidates did not extend L_2 and L_3 sufficiently and so a closed region could not be shaded.

Question 5(i)

5 The cubic equation $x^3+2x^2+3x+4=0$ has roots α, β and γ.

(i) Use the substitution $x=\frac{1}{u+1}$ to obtain a cubic equation in u with integer coefficients. **[4]**

Most candidates answered this question accurately, with only minor errors in the expansion of one of the required terms occurring.

Question 5(ii)

(ii) Hence, or otherwise, find the value of $\left(\frac{1}{\alpha}-1\right)\left(\frac{1}{\beta}-1\right)\left(\frac{1}{\gamma}-1\right)$. **[3]**

Those who understood that the required value came from the co-efficients in their answer to **(i)**, usually used the correct result. Candidates who tried to express the required value in terms of the symmetric functions of the original equation, often made an algebraic error, while others used values of the symmetric functions from the new cubic equation. It was pleasing to see that a number of candidates did use both methods to check their result.

Question 6(i)

6 **(i)** Find $\sum_{r=1}^{n} r(r^2+r-7)$, giving your answer in a fully factorised form. **[5]**

A sequence $u_0, u_1, u_2, \ldots$ is defined by

$$u_0 = 5,\ u_n = u_{n-1} + n^3 + n^2 - 7n \text{ for } n \geqslant 1.$$

Most recognised that this required the linear combination of three standard results and most quoted them correctly. A significant number did not use the common factor of $n(n+1)$ at an early stage, but expanded to obtain a quartic expression. This often led to an error in simplification, which then resulted in the factorisation being more difficult than was required. Those who used the common factor at an early stage usually found the correct answer, quickly and accurately.

Question 6(ii)

(ii) By considering $\sum_{r=1}^{n}(u_r - u_{r-1})$, find a formula for u_n in terms of n. **[3]**

[You do not need to factorise your answer.]

This part was not answered well. Many candidates made no attempt, while many others did not appreciate that $\sum_{r=1}^{n}(u_r - u_{r-1}) = u_n - u_0$, with many just stating that $u_n =$ their answer from **(i)**

Question 7(i)

7 The complex number $a + 3\mathrm{i}$ is a root of the quadratic equation

$$z^2 - (7+\mathrm{i})z + 16 + k\mathrm{i} = 0,$$

where a and k are positive real numbers.

(i) Find the value of a and the value of k. **[7]**

There are a number of correct methods for solving this part of the question. The most frequently seen was to substitute the root into the given quadratic equation, and then equate real and imaginary parts to find the possible values of *a* and *k*, usually explaining clearly why the negative value of *k* is disregarded. Completely correct solutions were seen when the candidates used alternative methods. However, a significant number started by assuming that the second root is the conjugate of the one given, which meant that few marks could be earned.

Question 7(ii)

(ii) Hence find the other root of the quadratic equation. **[2]**

Again, many quoted the conjugate of their answer to **(i)** rather than attempting to use either the sum of the roots (or the product of the roots) of the original quadratic equation.

Question 8(i)

8 The matrix **A** is given by $\mathbf{A} = \begin{pmatrix} a & 1 & -2 \\ -1 & a & 0 \\ 2a & 3 & 1 \end{pmatrix}$, where a is a real constant.

(i) Show that **A** is non-singular. **[4]**

Most realised that the determinant of matrix **A** was required and demonstrated sound knowledge of how to find it, with only minor errors in signs being the most common loss of marks. However, the explanation of why **A** is non-singular was often poor, stating that det **A** ≠ 0 but giving no justification of this.

Question 8(ii)

(ii) Find $\mathbf{A}^{-1}$. **[4]**

The method of finding the inverse matrix was clearly understood by the majority of candidates, with minor sign or algebraic errors being the most common loss of marks.

Question 8(iii)

(iii) Hence solve the three simultaneous equations given below.

$$\begin{aligned} ax + y - 2z &= 2 \\ -x + ay &= 1 \\ 2ax + 3y + z &= 0 \end{aligned}$$

[3]

Some candidates attempted to solve the equations algebraically, rather than use the inverse matrix found in **(ii)**. Those who used the inverse matrix generally found the correct solutions.

Question 8(iv)

(iv) Explain briefly why these equations have a unique solution. **[1]**

As in **(i)**, the explanations of the unique solutions to the given equations were rather poor, some actually stating that the solutions were not unique, as *a* can take any value.

Question 9(i)

9 The matrix **M** is given by $\mathbf{M} = \begin{pmatrix} m & m \\ 0 & 1 \end{pmatrix}$, where m is a positive constant.

(i) Find $\mathbf{M}^2$ and $\mathbf{M}^3$ in terms of m. **[4]**

The majority of candidates answered this part correctly.

Question 9(ii)

(ii) Hence suggest a suitable form for the matrix $\mathbf{M}^n$, where n is a positive integer, $n \geqslant 2$. **[2]**

The majority of errors occurred in the top right element, with $m^n + m^{n-1}$ being given or $m^n + m^{n-1} + \ldots$, and not indicating clearly that the sum ends with the value m. Some expressed this element as the sum of a G.P. correctly, but this did make the work in **(iii)** slightly more complicated.

Question 9(iii)

(iii) Use induction to prove that your answer to part **(ii)** is correct. **[4]**

Most candidates made a good attempt at the induction step. However, many stated that the base case was $n = 1$ instead of $n = 2$, and a significant number did not give a clear explanation of the induction process, thus losing the last mark.

Supporting you

For further details of this qualification please visit the subject webpage.

Review of results

If any of your students' results are not as expected, you may wish to consider one of our review of results services. For full information about the options available visit the OCR website. If university places are at stake you may wish to consider priority service 2 reviews of marking which have an earlier deadline to ensure your reviews are processed in time for university applications.

activeresults

Active Results offers a unique perspective on results data and greater opportunities to understand students' performance.

It allows you to:

- Review reports on the **performance of individual candidates**, cohorts of students and whole centres
- **Analyse results** at question and/or topic level
- **Compare your centre** with OCR national averages or similar OCR centres.
- Identify areas of the curriculum where students excel or struggle and help **pinpoint strengths and weaknesses** of students and teaching departments.

http://www.ocr.org.uk/administration/support-and-tools/active-results/

CPD Hub
Your route to OCR's teacher training

Attend one of our popular CPD courses to hear exam feedback directly from a senior assessor or drop in to an online Q&A session.

https://www.cpdhub.ocr.org.uk

The small print

We'd like to know your view on the resources we produce. By clicking on the 'Like' or 'Dislike' button you can help us to ensure that our resources work for you. When the email template pops up please add additional comments if you wish and then just click 'Send'. Thank you.

Whether you already offer OCR qualifications, are new to OCR, or are considering switching from your current provider/awarding organisation, you can request more information by completing the Expression of Interest form which can be found here: www.ocr.org.uk/expression-of-interest

OCR acknowledges the use of the following content:
Square down and Square up: alexwhite/Shutterstock.com

Please get in touch if you want to discuss the accessibility of resources we offer to support delivery of our qualifications: resources.feedback@ocr.org.uk

Looking for a resource?

There is now a quick and easy search tool to help find **free** resources for your qualification:

www.ocr.org.uk/i-want-to/find-resources/

www.ocr.org.uk

OCR Customer Contact Centre

General qualifications

Telephone 01223 553998
Facsimile 01223 552627
Email general.qualifications@ocr.org.uk

Cambridge Assessment

CERTIFIED ISO 9001 UKAS MANAGEMENT SYSTEMS 001