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Examiners' report

MATHEMATICS A

H240

For first teach in 2017

H240/02 Autumn 2021 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.

	Reports for the November 2021 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 responses.

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.

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Paper 2 series overview

Many candidates showed contrasting levels of expertise in the various questions. The impression given was that some candidates' coverage of the syllabus was more uneven than in a normal year.

Nevertheless, the overall standard was similar to that in 2019 (i.e. a normal year), with a range of marks from high ability to low ability. Very few candidates scored below 20%.

Candidates who did well on this paper generally did the following:	***Candidates who did less well on this paper generally did the following:***
• They understood hypothesis testing well. • Their skills using vectors were good. • They were able to interpret statistical diagrams. • They were able to break a problem down into its constituent parts.	• They had a reasonable grasp of basic calculus and algebra but struggled with more involved mathematics. • They had less understanding of hypothesis testing. • Their vector skills were of a lower ability.

Section overview

In Pure Mathematics candidates generally answered the early questions well. Many struggled with the concept of a proof, as did many with vectors.

In Statistics candidates generally performed well on the straightforward probability questions, but less well on the interpretation questions and the hypothesis test questions.

Themes in candidate responses

In written answers, candidates frequently wrote far more than was necessary to gain the relevant marks.

Some candidates resorted to trial and improvement methods. These are usually not given full credit, even if the correct answers are given.

Some candidates did not show sufficient working, and so lost marks. Candidates need to be made aware of the significance of words such as 'Detailed reasoning' and 'Determine'. These are explained in section '2d. Command words' of the specification.

The specification (in paragraph 2.05a) states that the hypotheses for a hypothesis test must be stated in terms of the relevant parameter. In addition to this, the parameter must be defined in context and must be clearly described as the population value. When carrying out the hypothesis tests (in Questions 10(b) and 11(d)), many candidates did not define the relevant parameter clearly, thus losing a mark. Others gave the hypotheses in words, not in terms of the parameter.

Comments on responses by question type

Question 3: Some candidates treated 88 as the last term of the 10 terms whose sum is 310.

Question 4(f): Some candidates appeared not to understand how to address some aspects of Assessment Objective AO3 (please see section '3b. Assessment Objectives' of the specification). Here, they seemed unfamiliar with the concept of refining a model. To gain the mark candidates needed to give a revised version of the formula. Descriptions given in words were almost always inadequate.

Question 5: Most candidates coped well with part (a), but many made no headway with part (b). A few correctly stated that the centre of the circle is (3, 2), but without explanation. It seemed that they were assuming that AC is a diameter, but many gave no justification for this. Some others began with $(x - a)^2 + (y - b)^2 = r^2$. They then got lost in algebra involving 4 or 5 letters, or they tried substituting various values into this equation. Some recognised the need to find another perpendicular bisector, but used an endpoint, instead of a midpoint, when finding the equation of the line.

Question 6(b): Many candidates attempted to use the trapezium rule, which did not answer the question that was asked. Some found the mean of all the means of the two bounds, missing the point that the bounds are converging towards the actual value of the area.

Question 6(c): Very few candidates understood what was required. This question addressed directly paragraph 1.08g of the specification (about integration as the limit of the sum of areas of rectangles), but almost no candidates made this connection.

Question 7: Most candidates knew how to start and gained at least 2 marks. However, few knew how to use the small angle approximations correctly. In some cases, they substituted cos h = 1 and sin h = h without explanation. Many candidates gave an incorrect version of a limit, stating that $\lim_{h\to 0} \frac{\cos x - 1}{h} = 0$.

Others went straight from $\lim_{h\to 0} \frac{\cos x \cosh - \sin x \sinh - \cos x}{h}$ to cos x − sin x − cos x, which is incorrect.

To gain full marks, candidates needed to state explicitly the small angle approximations for cos h and sin h, and then show these substituted into the relevant expression. (For cos h, either cos $h \to 1$ or cos $h \to 1 - \frac{h^2}{2}$ was acceptable.)

Question 8(b): Many candidates missed the point of this question – namely that part (a) provides two factors of K. Some who realised this, did not discuss whether one of the two factors might be equal to 1, and/or whether the two factors might not be distinct.

Question 9(b): Most candidates correctly noted that $\overrightarrow{OF}$ = **a** + **b** + **c**, and that consequently $\overrightarrow{OF}$ is a multiple of $\overrightarrow{OX}$. However, few went on to make the crucial point – that this implies that X lies on OF.

Question 10(a): Many candidates gave a general answer, perhaps learned by rote: "Because the researcher is looking for either an increase or a decrease, not both." This does not reflect the actual context of the question, so did not gain the mark.

Question 11(c): The specification (paragraph 2.02j) gives two definitions for an outlier. Most candidates used only one of these definitions, and so did not discover that they give different results. What was required for full marks was a recognition of the uncertainty about whether or not 30 should be considered an outlier. Candidates who used other definitions (such as $x > \mu + 3\sigma$ or $x > \mu + \sigma$) gained no credit. Some candidates did a calculation that mixed the median with the standard deviation or the mean with the IQR.

Question 12(e): A common error in the numerator was to use P(A $\cap$ B) = P(A) × P(B) rather than P(A $\cap$ B) = P(A) × P(B/A), i.e. in this case the numerator was incorrectly evaluated using 0.216 × 0.42 instead of $2 \times 0.3^2 \times 0.7$.

Question 13: Because questions of this kind generally involve inference, rather than deduction, there is not always one single, precisely correct answer to any particular question. This is a result of the increased emphasis, in the new Statistics specification, on interpretation as compared to calculation. Various answers were acceptable in each part of this question. Centres are referred to the published mark scheme for details of these.

Common misconceptions

?	**Misconceptions**	Question 2: Many candidates considered the change of sign of the gradient, rather than the change of sign of f(x). Presumably they were confusing this question with a question about stationary points. Question 4(a): Some candidates assumed that, because P = 5000 − some quantity, the maximum size of P is 5000. This ignores the fact that cos (30t) is negative for some values of t Question 8(b): Many candidates misinterpreted the question. They tried to use a discriminant, thinking that the question was about distinct roots of an equation, rather than distinct factors of an expression. Another misconception shared by many candidates was that it was necessary to distinguish between the cases where n is even and where n is odd. This technique has been necessary in several 'proof' questions in recent past papers, but in this case it is irrelevant. Other candidates tried to 'prove' the result by giving specific values to n. Question 9(a): Some candidates attempted 'lengths' of vectors, rather than vectors themselves. For example, they wrote $\overline{OM} = \frac{1}{2}\sqrt{b^2 + c^2}$, rather than $\overline{OM}$ = $\frac{1}{2}$(**b** + **c**). Questions 10(b) and 11(d): One difficult feature of hypothesis testing is that in some cases the calculated value of the statistic is significant when it is **greater** than the critical value, whereas in other cases the calculated value is significant when it is **less** than the critical value. In both these questions there was confusion about this. Question 11(d): Many candidates used the sample mean, 21, as the mean of the distribution, rather than the suggested population mean of 20. Question 13(c)(ii): Most candidates appeared to be unfamiliar with the comment in row 21 of the Information Sheet at the beginning of the Large Data Set: "The method of travel used is for the longest part, by distance, of the usual journey to work." They assumed that employees using the Park and Ride would report both methods of travel in the census. It would be helpful for centres to make candidates aware of the Information Sheet, and particularly row 21 and the terminology in rows 8 to 12. Question 14(c): A common misconception was to interpret P($X_1 > X_2 + X_3$) to mean that it is required to find three values of X such that the probability of the 1st value is greater than the sum of the probabilities of the 2nd and 3rd values.

i	**OCR support**	Guidance for working with questions based on the Large Data Set, like Question 13, is provided in our Notes on the large data set resource.

Key teaching and learning points – comments on improving performance

As noted above, candidates need to be made aware of the significance of words such as 'Detailed reasoning' and 'Determine'. These are explained in section '2d. Command words' of the specification. For example, in Question 3, some candidates obtained the correct two linear equations, and then used the relevant calculator function to write down the answers, without showing a substitution or elimination method. Because the question says 'Determine' (which means 'Show working to find . . .') these candidate lost a mark. The reasoning behind this approach is that it is desirable to test (at least on some occasions) candidates' understanding of techniques such as solving equations and definite integration, rather than just testing whether candidates can use the relevant calculator function, with or without understanding.

Some candidates find it difficult to master the logic behind hypothesis testing. However, the correct way to express the hypotheses can largely be learned 'by rote'. The correct form of the conclusion can also be learned by rote, but it is unlikely that candidates will score marks for the conclusion unless it is preceded by correct working involving the relevant distribution, and comparison with a critical value.

Guidance on using this paper as a mock

This paper is quite suitable for use as a mock exam. However, it is worth noting that the total number of questions requiring verbal rather than numerical answers is a little more than in the corresponding papers in 2019 and 2020. (But note that this precedent may or may not be followed in future papers.)

When using this paper as a mock, it is important to make use of the published mark scheme, particularly for Questions 7, 8(b) and 13.

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