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Examiners' report

MATHEMATICS A

H240

For first teach in 2017

H240/03 Autumn 2021 series

Version 1

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.

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Paper H240/03 overview

This is the third examination component for the A Level examination for GCE Mathematics A. It is a two-hour paper consisting of 100 marks which tests content from Pure Mathematics (Section A, 50 marks) and Mechanics (Section B, 50 marks). Pure Mathematics content is tested on all three papers, and any topic could be tested on any of the three papers.

Inevitably, the report that follows will concentrate on aspects of the candidates' performance where improvement is possible to assist centres on preparing candidates for future series. However, this should not obscure the fact that a significant number of candidates who sat this paper produced solutions which were a pleasure for examiners to assess. Many candidates demonstrated a most impressive level of mathematical ability and insight which enabled them to meet the various challenges posed by this paper in both sections of the paper. Candidates that scored well demonstrated nice precision, confident command of correct mathematical notation and excellent presentational skills.

The specification includes some guidance about the level of written evidence that needs to be seen; this reflects the changes introduced in the assessment objectives and also the increased functionality of the available calculators, since there is a significant change from the equivalent legacy qualifications.

The word 'determine' in a question does not simply imply that candidates should find the answer but, to quote the specification, 'this command word indicates that justification should be given for any results found, including working where appropriate.' This command word features in Question 3, 4(c), 6(b), 7(b), 9(b) and throughout the Mechanics section.

The phrase 'Show that' generally indicates that the answer has been given, and that candidates should provide an explanation that has enough detail to cover every step of their working. This command phrase features in Questions 2(a), 6(a), 8(a), 8(b), 10(b) and 14(a).

While there is no specific level of working needed to justify answers to questions which use the command word 'find …', method marks may still be available for valid attempts that do not result in a correct answer, and standard advice (included in the specification) is that candidates should state explicitly any expressions, integrals, parameters, and variables that they evaluate with a calculator. Furthermore, they should use correct mathematical notation rather than model specific calculator notation.

There was one example in Question 3(b) where the question specifically asked for exact values, an approximate decimal equivalent did not gain full credit.

Conversely Questions 5(a), 6(c) and 14(b) specified the level of accuracy to give the final answer. Regardless of the final required accuracy, candidates should be careful of not rounding prematurely, but also take care to avoid over specifying rounded answers where the context does not support that level of accuracy.

	**OCR support**	Candidates should understand the requirements expected when a question uses a command word such as 'determine' or 'show that'. In these cases, the examiner will be assessing whether the candidate is explaining each step of their process; method marks are not given unless steps are clear. The command words are defined in the specification and a student summary guide can be found in the Assessment section of the H240 qualification page on the OCR website: A Level Maths command words poster.

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Candidates who did well on this paper generally did the following:	*Candidates who did less well on this paper generally did the following:*
• Used formal mathematical language and notation. • Understood the level of response required for the command words used in the questions. • Made efficient use of their calculator. • Read questions carefully and provided the answers that were requested.	• Made careless mistakes in algebraic manipulation. • Did not give sufficient evidence on 'Show that' and 'Determine' questions. • Provided mathematical working that was correct but did not answer the specific question that was asked. • Used imprecise notation or language.

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Section A overview: Pure Mathematics

Content from the Pure section of the specification may be assessed on any of the three papers of H240. Many candidates appeared well prepared for the pure content, with method marks being given, but there were several places where a more concise use of algebraic notation and language may have led to more of the corresponding accuracy marks being available. There were several 'Show that' and 'Determine' requests where there were marks given for the quality of the mathematical argument.

Themes in candidate responses in Section A

Question 2(b)

Candidates struggled to see the link between part (a), in which most candidates were successful in applying the cosine rule to derive the given result of $p^2 = 16 + 3h^2$, and the demand in (b) to find a three-term approximation for p in powers of h. Most candidates did not realise that a binomial expansion was required and instead tried to use, quite surprisingly, small-angle approximations (even though the expression for p^2 did not contain any trigonometric terms).

?	**Misconception**	Candidates need to be aware that just because a question says, 'h is small' does not necessarily mean that the question is testing the topic of small-angle approximations.

Question 3

While most candidates could successfully set up and solve the required equations to find the value of d a number did not explain correctly why the value obtained implied that the sequence was increasing.

Question 4(b)

For the one mark available here it was not sufficient to simply say that because $y = |x - 1|$ and $y = \frac{k}{x}$ had only one point of intersection that therefore the equation $x|x - 1| = k$ had only one real root.

Candidates had to make a link between the two graphs and the corresponding equation.

Question 6

It was clear that many candidates struggled with this question even though it was relatively routine in nature. The notation, arcsin, clearly confused some candidates even though it is given in the specification.

?	**Misconception**	Candidates need to be aware that radians should be used for trigonometric graphs and functions.

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Section B overview: Mechanics

The Mechanics content is only assessed in section B of this final H240 paper. Mechanics has traditionally proved to be the more challenging strand in A Level Maths, and while this was a small, unusual cohort, it was pleasing to see a good proportion of the questions attempted in this section of the paper.

While this section will naturally focus on Mechanics topics, there is an expectation that candidates are still careful with their written presentation. The best attempts to questions often include an appropriate diagram, and generally demonstrate careful algebraic notation.

Candidates should read questions carefully and take special notice of explicit or implied (i.e., through inspection of the powers of t in expressions) descriptions of acceleration. Question 9 states constant acceleration so '*suvat*' can be used, whereas Question 13 has a variable force term so calculus must be used.

Numerical answers are generally expected to be given to 3 significant figures, unless an 'exact' value is explicitly requested (generally to be subsequently used within the question).

Themes in candidate responses in Section B

Question 10(b)

	**Misconception**	It was clear that in this question candidates had the misconception that as the 'show that' contained an inequality that this meant that the magnitude of the frictional contact force F was either $F \leq 15\cos\theta$ or $F \geq 15\cos\theta$. As the block was at rest, the forces acting on the block horizontally were in balance and therefore $F = 15\cos\theta$. As the block was not in limiting equilibrium then $F \leq 0.2R$ and the normal contact force R could be found by resolving vertically (and if done correctly was given by $R = 15\sin\theta + 50$.)

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Question 12(b)

This was found to be the most demanding part of the paper. Most candidates did not realise that as the question asked for the largest possible value of m the most efficient way of finding this was to take moments about D as the tension in the rope at C would be zero. Most candidates who took moments about C still assumed the information about the relationship between the tensions in the two ropes from the stem to (a) still applied instead of realising that the tension in D would now be of magnitude $20g + mg$.

Question 14(a)

Candidates are reminded to read the question carefully as the question asked candidates to find an equation involving μ, a and g, many instead tried to find an inequality involving a and g only.

	**AfL**	When applying Newton's second law in problems involving connected particles, candidates are strongly advised to apply $F = ma$ for each particle separately rather than trying to apply it for the whole system. Candidates are rarely successful in these 'whole system' attempts and very few marks can be given in this case.

Question 14(b)

	**Misconception**	The 'magnitude of the contact force' is not simply the sum of the frictional contact force F and the normal contact force R (or even just R) but is given by $\sqrt{F^2 + R^2}$.

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