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Examiners' report

MATHEMATICS A

H240

For first teach in 2017

H240/01 Autumn 2020 series

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 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.

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Paper 1 series overview

H240/01 is one of the three examination components for the A Level examination for GCE Mathematics A. It is a two-hour paper consisting of 100 marks, which tests Pure Mathematics topics. Pure Mathematics topics are also tested on the first half of Papers 2 and 3, and any Pure Mathematics topic could be tested on any of the three papers.

To be successful on this paper, candidates need to be familiar with all areas of the Pure Mathematics content and be able to apply it to a variety of questions, including multi-step questions and those set in context.

Candidates should pay close attention to the command words used in the questions and make sure that their solution includes sufficient detail and justification.

	**OCR support**	Candidates should understand the requirements expected where a question (such as Q11) states '**In this question you must give detailed reasoning'** or 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 on the assessment tab of the H240 qualification page on the OCR website: A Level Maths command words poster.

On all questions they should show their method clearly, which will allow partial credit to be given should the solution not be fully correct. If multiple attempts are made at a question, candidates should clearly identify which attempt they wish to be marked, crossing through all other attempts.

Candidates should make sure that they are familiar with the formulae given at the start of the question paper. They should also make sure that they appreciate which formulae will not be given and have learnt them (for example, for arithmetic and geometric series the formulae for the sums are given but not for the *n*th terms).

Candidates are expected to make effective use of their calculator, but not to become overly reliant on them or omit crucial detail from their solutions.

	**OCR support**	Guidance on the use of technology to support teaching and learning and the use of calculators in the examination can be found in the qualification specification. A student summary poster can be found on the planning and teaching tab of the H240 qualification page on the OCR website: Maths calculator use poster

Candidates who did well on this paper generally did the following:	***Candidates who did less well on this paper generally did the following:***
• Gave clear detail of their method, especially on 'show that' questions. • Demonstrated a good understanding of the command words and structured their response accordingly. • Showed good subject knowledge across the entire specification.	• Gave insufficient detail in 'show that' questions, running several steps resulting in a solution that was not fully convincing. • Did not provide justification for their solution in response to the command work 'determine'. • Seemingly had gaps in knowledge, especially in areas that are new to this specification compared to the previous 7890.

Comments on responses

Question 1

In Question 1 some candidates did not seem familiar with this topic and were seemingly unaware that the relevant approximations are given in the list of formulae.

Question 3

The first part of Question 3 required candidates to show the derivation of the given equation. On questions such as this, where the request is to 'show that' a given answer is correct, it is important that sufficient detail is given to provide a convincing solution. Examiners expected to see an equation for the volume, an expression for the total surface area and then clear substitution and manipulation to arrive at the given answer. In the second part of the question, a surprisingly common error was to find the radius but then omit to find the minimum surface area. Candidates should review a question to make sure that it is fully answered before moving on; other strategies such as highlighting or underlining key words and phrases within a question may also be helpful.

Question 4

Question 4 was intended to be a very straightforward question on proof by contradiction. Some concise and elegant solutions were seen, but many others indicated a lack of familiarity with the required structure.

Question 6

In the first part of Question 6 a number of candidates attempted a worded explanation as opposed to reducing the equation to linear form which is then linked to the equation of a straight line. A lack of precision resulted in some candidates not gaining full credit, as they neglected to indicate that they were using logs to base 10. In part (b) the expectation was that candidates would use the relevant parameters from their linear equation; an alternative, and equally acceptable, strategy was to identify coordinates of points on the straight line and use them in the given exponential equation; this is a good example of candidates who could not answer part (a) finding a method that still allowed them to attempt this part of the question. In part (d) any sensible reason that identified why the sales may not continue at the same rate was allowed, but a number of solutions were too vague to gain credit. Candidates were also given credit if they identified that extrapolation was unreliable.

Question 7

The final part of Question 7 was another example of where candidates were expected to give clearly explained and sensible answers. Many could identify that there will eventually not be enough hours in the day, but finding a reason on a different theme for their second answer proved more problematical.

Question 8

The second part of Question 8 proved to be challenging; some candidates did not seem familiar with the definition of an increasing function and were unsure how to proceed whereas others stated that the first derivative needed to be positive, but then continued by considering the second derivative instead. Of the minority who attempted the correct method, many gave vague statements such as 'the quadratic is always positive' but with no evidence to support this. In a 'show that' question, sufficient detail must be provided so as to be convincing. Equally, statements must be fully correct so stating that e^{2x} is never negative lacks the required precision.

Question 9

The most successful candidates in Question 9(b)(i) were those who considered a graphical approach (which the diagram was included to help with) as opposed to those who embarked on the more standard techniques for a question involving moduli.

Question 10

It was apparent in Question 10 that many candidates were not familiar with the concept of using rectangles to establish upper and lower bounds. The most common error was to instead use the trapezium rule, often attempting to then establish bounds for their final answer. In part (b)(i) it was a given answer so sufficient detail was required, and in part (b)(ii) it was again a given answer so there had to be some evidence of the change of limits (assuming that candidates were now working in *t*) and also that the lower limit of $t = 0$ had been considered rather than just ignoring it.

Question 11

Question 11 was the only '**In this question you must show detailed reasoning**' question on the paper, and candidates were expected to show a detailed and complete analytical method. Part (a)(i) was generally very well answered, but the remainder of the question proved challenging. Part (ii) is a good example of where candidates have to link different topic areas – they are considering a quadratic equation and the fact that the line is tangential should indicate that the required strategy is to equate the discriminant to 0. Candidates struggled with the non-standard aspect of part (b), although some were able to gain some credit for working out relevant lengths and a relevant trigonometric ratio. Of the few that were so far successful, they were expected to continue to work in exact values to justify the request in the question, which not all candidates appreciated.

Question 12

Question 12 was the final question on the paper and was generally well answered, with a number of candidates able to make good progress in this unstructured, multi-step question. As the question did not require 'detailed reasoning', calculator use to find the roots of the cubic denominator was acceptable. However, when then working backwards from the roots to the factors, it was fairly common to lose the lead coefficient of 2 with the expected factor of $(2x-1)$ being given as $(x-0.5)$ but with no compensation in the other factors. Candidates who took the longer method of identifying a factor, carrying out algebraic long division and then finding the other two linear factors were usually more successful. This demonstrates the need for candidates to know how to use the calculator functions effectively and accurately. The remainder of the question was generally well attempted, although only the most able candidates gained the final mark for correctly dealing with both the indices and the constant of integration when removing the logarithms to make *y* the subject.

Common misconceptions

One common misconception was commenting on the model in Question 7; a number of candidates commented on why the revision programme may be difficult for the student to implement (e.g. may get bored and not want to revise) as opposed to why it may not be realistic.

Key teaching and learning points – comments on improving performance

Candidates need to be aware of the command words that are used, and the implication for the detail in their solutions. 'Determine' was used in a number of questions and candidates should appreciate that this indicates that justification should be given; just stating the answer is unlikely to attract much, if any, credit.

When commenting on the reliability of a model, or how realistic it may be, candidates are expected to give a sensible, specific reason; vague comments that refer just to 'other factors' are insufficient.

It is essential that candidates are familiar with all areas of the specification; on this paper a number of candidates seemed less confident on topic areas that did not feature on the legacy 7890 specification, namely small angle approximations, proof by contradictions and upper and lower bounds.

i	**OCR support**	Section 2d in the specification gives explanations and examples of the command words; this should be shared with the candidates. Sections 5c (mathematical notation) and 5d (mathematical formulae and identities) should also be shared. Mathematics A H240 specification

i	**OCR support**	A student revision checklist for Mathematics A H240 can be downloaded from the OCR website.

Guidance on using this paper as a mock

When marking the mock examination, teachers should pay close attention to the additional guidance in the mark scheme to make sure that lack of sufficient detail in a solution is clearly identified and feedback given to the candidates as to what additional detail was required.

Supporting you

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