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Examiners' report

MATHEMATICS A

H240

For first teaching in 2017

H240/01 Summer 2023 series

Version 1

Contents

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. A selection of candidate answers is also provided. 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 and the mark scheme can be downloaded from OCR.

Paper 1 series overview

H240/01 is a two hour paper, consisting of 100 marks, which tests the Pure Mathematics topics. It is one of the three examination units for the GCE Mathematics A qualification. Pure Mathematics topics are also tested in the first half of H240/02 and H240/03, and any topics could be tested on any of the three papers.

To be successful on this paper, candidates need to be familiar with the entire specification including any required GCSE knowledge. They should be aware of which formulae are given at the start of the paper, and also make sure that they can accurately recall those that are not given. Candidates should be able to make efficient use of their calculator where appropriate, checking that it is in the correct mode for questions involving trigonometry.

Candidates should make sure that they are familiar with the 'command words' and appreciate the necessary detail that will be required in these types of questions. When showing a given answer, candidates must include sufficient detail in their solutions so as to be convincing, and try to not include more than one step in a single line of working. If they realise that there is an error in their solution, then this must either be clearly corrected throughout or the solution deleted and a new solution started afresh. If candidates do make multiple attempts at a question then they must clearly indicate which attempt they wish to be marked.

Candidates must use mathematical language and notation correctly, including set notation if required. They should show clear method in their solutions, such as explicit substitution of values, to allow partial credit to be given to a solution that is not fully correct. They should also make sure that their handwriting is legible so as to allow maximum credit to be given (and avoid introducing errors).

If questions are set in context then candidates should make sure that their answer is also in context, paying attention to units and also whether an integer, a fraction or a rounded decimal answer is appropriate. When commenting on the limitations of a model, explanations must be detailed and include specific reasons as appropriate.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• made effective use of diagrams • made sure that their calculator was in the correct mode when answering questions involving trigonometry • paid close attention to the command words in a question • showed clear method to allow partial credit to be given when a solution was not fully correct • gave sufficient detail in worded solutions.	• did not provide sufficient detail and clarity when structuring their solutions • did not appreciate the links between different parts of a question • made vague comments rather than giving specific examples • lacked fluency on GCSE/AS topics • were inflexible in their approach rather than considering the most effective method to answer a question • did not set out work in a clear and legible form which may have led to errors incorporated into subsequent steps of a mathematical argument.

Question 1 (a)

1 In the triangle ABC, the length $AB = 6$ cm, the length $AC = 15$ cm and the angle $BAC = 30°$.

(a) Calculate the length BC. **[2]**

For many candidates this proved to be a straightforward start to the paper. They were able to apply the cosine rule accurately to find the length of *BC*, although a few did not confirm which trigonometric mode their calculator was in. Given that this is a GCSE topic, there was a surprising number of candidates who struggled to make progress, with some quoting an incorrect formula, some that attempted to solve with multiple applications of the sine rule, and others that considered the triangle to be right angled.

Question 1 (b)

D is the point on AC such that the length $BD = 4$ cm.

(b) Calculate the possible values of the angle ADB. **[3]**

In the most successful responses candidates sketched a diagram to represent the given information, and were then able to attempt the use of the sine rule. Many gained the first 2 marks with ease, although the second angle was not always attempted. Some candidates were either unable to position the point *D* in the correct location or attempted an angle other than the one requested. A common error was to assume that the length found in part (a) was to be used in this part of the question, resulting in a more lengthy solution which did not always maintain the required degree of accuracy.

Question 2 (a) (i)

2 **(a)** **(i)** Show that $\frac{1}{3-2\sqrt{x}} + \frac{1}{3+2\sqrt{x}}$ can be written in the form $\frac{a}{b+cx}$, where a, b and c are constants to be determined. **[2]**

The majority of candidates were able to provide a fully correct solution, which included sufficient detail as indicated by the command words of 'show that' and 'determined'.

Question 2 (a) (ii)

(ii) Hence solve the equation $\frac{1}{3-2\sqrt{x}} + \frac{1}{3+2\sqrt{x}} = 2$. **[2]**

Candidates who had found the correct expression in part (a) invariably scored both marks in this part of the question. Those with an incorrect expression could still pick up the method mark, as long as their fraction was of the required form.

Question 2 (b)

(b) In this question you must show detailed reasoning.

Solve the equation $2^{2y} - 7 \times 2^{y} - 8 = 0$. **[4]**

Most candidates could identify this as a disguised quadratic and make a good attempt to solve it, either directly or by using a substitution. As it is a 'detailed reasoning' question candidates were expected to show explicit detail of their solution method, and the majority did indeed do so. In addition to obtaining the correct root of $y = 3$ candidates also had to explain why $2^y = -1$ would yield no further roots. This was generally done well, although some candidates need to take more care with their use of mathematical language; saying that logs cannot be negative is not the same as saying that the log of a negative number cannot be taken. A common misconception was the belief that the equation was actually a disguised cubic, from the misapplication of the order of operations.

OCR support

Some candidates did not seem familiar with the command words, such as 'detailed reasoning', 'show that' and 'determine'. These are detailed in the specification, and OCR have also produced a command words poster for display in the classroom.

Question 3 (a)

3 (a) Given that $f(x) = x^2 + 2x$, use differentiation from first principles to show that $f'(x) = 2x + 2$. **[4]**

Most candidates were apparently familiar with differentiation from first principles and could produce a convincing proof to justify the given derivative. When producing a proof, candidates should avoid rolling a number of steps together as it can result in a solution that is not entirely convincing. In this proof, candidates should first simplify the numerator by expanding the bracket and gathering like terms, and then divide by h, rather than doing both steps in one go. Some, otherwise correct, solutions were spoiled by a lack of correct notation, including $f'(x)$ and lim $h \to 0$, despite these being given in the formula at the start of the paper. A common error was not making correct use of brackets, resulting in a sign error when considering $-f(x)$. Some candidates clearly noticed this and attempted to fudge the simplifying of terms, but best practice would be to check each and every line of the proof carefully, amending as necessary.

Exemplar 1

3(a)

$$f'(x) = \lim_{h\to 0} \frac{f(x+h) - f(x)}{h}$$

$$= \lim_{h\to 0} \frac{(x+h)^2 + 2(x+h) - (x^2+2x)}{h}$$

✓ ✓

$$= \lim_{h\to 0} \frac{x^2+2xh+h^2+2x+2h-x^2+2x}{h}$$

$$= \lim_{h\to 0} \frac{2xh+h^2+\cancel{4x}+2h}{h}$$

$$= \lim_{h\to 0} 2x+h+2$$

$$= h\to 0 \quad 2x+2$$

↳ h goes away at 0

A sign error occurs on the third line of working. The candidate has realised on the next line that + 4*x* is incorrect, so deletes this term but doesn't correct the sign error on the previous line thus losing the A mark.

Assessment for learning

Students should be given a copy of the list of formulae at the start of the course, and encouraged to use this throughout rather than being reliant on textbooks and their notes. This will help candidates to be aware of which formulae are given (and which are not), as well as the format in which they are given.

Question 3 (b)

(b) The gradient of a curve is given by $\frac{dy}{dx} = 2x+2$ and the curve passes through the point $(-1, 5)$.

Find the equation of the curve. **[3]**

This part of the question was very well answered with the majority of candidates gaining full credit, either from noticing the link with part (a) or by starting the question anew.

Misconception

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A common misconception with this type of question is for candidates to assume that $y = mx + c$ can be used to find the equation, despite it being referred to as a 'curve' and the gradient not being constant.

Question 4 (a)

4 It is given that $ABCD$ is a quadrilateral. The position vector of A is $\mathbf{i}+\mathbf{j}$, and the position vector of B is $3\mathbf{i}+5\mathbf{j}$.

(a) Find the length AB. **[1]**

This part of the question was invariably correct, with the most common error being to simply find the vector *AB* as opposed to the length of this vector.

Question 4 (b)

(b) The position vector of C is $p\mathbf{i}+p\mathbf{j}$ where p is a constant greater than 1.

Given that the length AB is equal to the length BC, determine the position vector of C. **[3]**

Most candidates were able to make a good attempt at this question, setting up an expression for the length of *BC*, equating it to the length of *AB* and solving the resulting quadratic to obtain at least $p = 7$. Some candidates stopped at this point without appreciating that the position vector of *C* had been requested. The most common error was to use the distance *OC* rather than *BC*. Some candidates simply observed from the information given that *C* must be $7\mathbf{i} + 7\mathbf{j}$; this did gain some credit but the question uses the command word 'determine' so their answer had to be justified to gain full credit.

Question 4 (c)

(c) The point M is the midpoint of AC.

Given that $\overrightarrow{MD} = 2\overrightarrow{BM}$, determine the position vector of D. **[2]**

This part of the question proved to be unexpectedly challenging, and only the most able candidates gained both marks. Many candidates seemed unsure as to how to find the midpoint, with 3**i** + 3**j** most typically being given as the position vector of *M*. The more successful candidates made good use of a sketch diagram.

Question 4 (d)

(d) State the name of the quadrilateral $ABCD$, giving a reason for your answer. **[2]**

Only a minority of candidates were able to identify that the quadrilateral was a kite. So as to gain both marks, candidates also had to justify their answer with appropriate evidence, such as finding the lengths of *AD* and *CD*. Rather than considering the information given in parts (b) and (c) of the question, most candidates attempted to plot their sometimes incorrect position vectors, leading to erroneous conclusions.

Question 5 (a) (i)

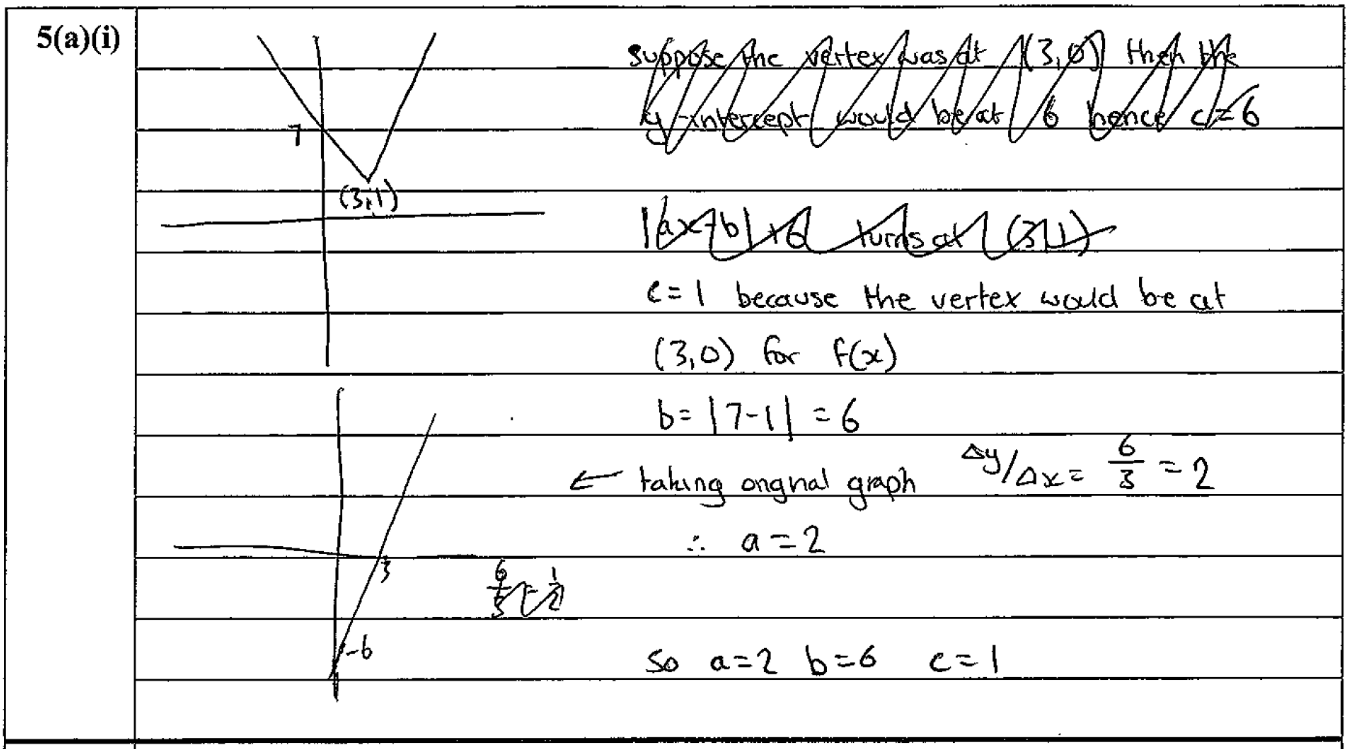
5 **(a)** The function $\mathrm{f}(x)$ is defined for all values of x as $\mathrm{f}(x) = |ax - b|$, where a and b are positive constants.

(i) The graph of $y = \mathrm{f}(x) + c$, where c is a constant, has a vertex at $(3, 1)$ and crosses the y-axis at $(0, 7)$.

Find the values of a, b and c. **[3]**

It was less usual for partial credit to be given in this question; solutions tended to be either fully correct or very limited progress was made. The most successful method was to use a sketch diagram and consider the vertical translation to obtain *c* = 1. The gradient and intercept of the straight line graph could then be considered to obtain values for *a* and *b*. In the less successful responses, candidates tended to try to employ routine methods such as substituting values and then squaring to deal with the modulus, rather than trying to develop a more flexible approach.

Exemplar 2


5(a)(i)

~~suppose the vertex was at (3,0) then the y-intercept would be at 6 hence c=6~~

~~$|ax-b|+c$ turns at (3,1)~~

$c=1$ because the vertex would be at (3,0) for $f(x)$

$b=|7-1|=6$

← taking orignal graph $\Delta y/\Delta x = \frac{6}{3} = 2$

$\therefore a=2$

~~$\frac{6}{3}=\frac{1}{2}$~~

So $a=2$ $b=6$ $c=1$

This candidate has made effective use of a sketch graph, and has considered the graph of $y = ax - b$ to find values for a and b.

Question 5 (a) (ii)

(ii) Explain why $f^{-1}(x)$ does not exist. **[1]**

The most convincing explanations referred to f being a many to one solution, sometimes even giving specific coordinates to support this statement. The most common error was a lack of precision in the explanation, simply referring to 'it' without explicitly referencing whether this was the function or the inverse function.

Question 5 (b) (i)

(b) The function $g(x)$ is defined for $x \geqslant \frac{q}{p}$ as $g(x) = |px - q|$, where p and q are positive constants.

(i) Find, in terms of p and q, an expression for $g^{-1}(x)$, stating the domain of $g^{-1}(x)$. **[3]**

In the more successful responses, candidates identified that the relevant part of the graph was $y = px - q$, and it was then a routine process to find the inverse function that matched this. Some candidates ignored the domain and considered both parts of the given function, despite the previous part of the question having identified that the inverse of an entire modulus function would not be defined. Once again some candidates went straight into attempting to square both sides, or even just one side, of the equation as this seemed to be their standard method when working with a modulus function. Candidates also found identifying the domain to be a challenge; most seemed familiar with the range of a function being the domain of the inverse function but were then unsure how to proceed. A few candidates did identify the condition of ≥ 0, but were unsure as to what, if anything, should go on the left hand side of the inequality.

Question 5 (b) (ii)

(ii) State the set of values of p for which the equation $\mathrm{g}(x) = \mathrm{g}^{-1}(x)$ has no solutions. **[1]**

There were very few correct solutions seen to this part of the question. These tended to come from considering the relationship between a function, its inverse and the line $y = x$. Candidates employing a more algebraic approach could sometimes identify the key value of $p = 1$, but then struggled to identify the required inequality.

Question 6 (a)

6 A curve has equation $y = \mathrm{e}^{x^2+3x}$.

(a) Determine the x-coordinates of any stationary points on the curve. **[4]**

This part of the question was generally well answered, with candidates providing detailed and convincing solutions. Most were able to differentiate the given function using the chain rule, whereas a few first introduced logs and then used implicit differentiation. Candidates then had to equate the derivative to 0, solve to find $x = -1.5$ and explain why the exponential term would not give any solutions when equated to 0.

Question 6 (b)

(b) Show that the curve is convex for all values of x. **[5]**

Most candidates were aware that the second derivative was required, and could make some attempt to find this, but the differentiation proved too challenging for many. Some candidates started the entire question by first splitting the given equation into the product of two exponential terms. When using this approach, the first derivative was usually correct but the second derivative rarely so. Most candidates gained a mark for identifying that the second derivative was always positive for a convex curve, and could attempt to show this. However, only the most able candidates were able to provide a convincing justification for this. To gain full credit candidates had to make mathematically correct statements throughout, so vague statements regarding 'squares always positive' could not be credited for the final mark.

Exemplar 3

6(b)

Convex $\frac{d^2y}{dx^2} > 0$

$\frac{dy}{dx} = (2x+3)e^{x^2+3x}$

Product Rule

$u = 2x+3 \quad v = e^{x^2+3x}$

$u' = 2 \quad v' = (2x+3)e^{x^2+3x}$

$\frac{d^2y}{dx^2} = (2x+3)^2 e^{x^2+3x} + 2e^{x^2+3x}$

$= e^{x^2+3x}\left((2x+3)^2+2\right)$

$e^{x^2+3x} > 0 \quad (2x+3)^2 > 0$

$\therefore (2x+3)^2+2 > 0$

$\therefore \frac{d^2y}{dx^2} > 0$

Hence shown that the curve is convex for all values of x as $\frac{d^2y}{dx^2} > 0$.

At the start of the solution the candidate gained a mark for stating the condition for the curve to be convex. They also gained 2 marks for a correct second derivative, with method clearly shown. They then attempted to show that this is always positive, but there was an error with the inequality sign; it should be $(2x + 3)^2 \geq 0$. They were still given the method mark for their attempt, but not the accuracy mark.

Misconception

A common misconception was to show that there was a single stationary point, and it was a minimum point, hence the curve must be convex for all x, without appreciating that points of inflection are not necessarily stationary points.

Question 7 (a)

7 **(a)** Use the result $\cos(A+B) = \cos A\cos B - \sin A\sin B$ to show that

$$\cos(A-B) = \cos A\cos B + \sin A\sin B.$$ **[2]**

It was a minority of candidates who could both identify the need to replace *B* with – *B*, and also provide suitable justification for the final answer.

Question 7 (b)

The function $f(\theta)$ is defined as $\cos(\theta+30°)\cos(\theta-30°)$, where θ is in degrees.

(b) Show that $f(\theta) = \cos^2\theta - \frac{1}{4}$. **[3]**

This part of the question was very well answered, with many fully correct solutions seen. Candidates who used the exact trigonometric values in the two separate identities before expanding the brackets tended to be more successful than those who expanded first.

Question 7 (c) (i)

(c) **(i)** Determine the following.

- The **maximum** value of $f(\theta)$
- The smallest **positive** value of θ for which this maximum value occurs **[2]**

Most candidates were able to identify that the maximum value would be 0.75, but finding the angle for which it occurred proved to be more challenging. A number of candidates did not appreciate that 0 is not positive. Even if 0° was discounted, a number of candidates gave the angle as 360°. It was only the more astute candidates who realised that 180° would also give a maximum value.

Question 7 (c) (ii)

(ii) Determine the following.

- The **minimum** value of $f(\theta)$
- The smallest **positive** value of θ for which this minimum value occurs **[2]**

In general candidates found it more difficult to identify the minimum value compared to the maximum in the previous part of the question. However, once – 0.25 had been found, the angle was also invariably correct.

Question 8 (a)

8 **(a)** Find the first **three** terms in the expansion of $(4+3x)^{\frac{3}{2}}$ in ascending powers of x. **[4]**

This question was very well answered, with the majority of candidates gaining full credit. The most successful responses saw candidates make effective use of brackets in the third term. The most common error was multiplying through by 4 rather than 8. Some candidates did attempt to use Newton's method; it was unclear whether they had been taught this method or whether they were selecting the incorrect formula, but it was rarely done correctly.

Question 8 (b)

(b) State the range of values of x for which the expansion in part **(a)** is valid. **[1]**

This was a routine question, with the condition given in the list of formulae at the start of the exam paper, yet barely half of the candidates were able to gain the mark. Common errors included not rearranging to a condition on *x*, losing the modulus sign when rearranging, starting with $|3x| < 1$ and even starting with $|4 + 3x| < 1$. Both the standard condition given in the list of formulae and the mathematically correct inequality (as $n > 0$) were accepted.

Question 8 (c)

(c) In the expansion of $(4+3x)^{\frac{3}{2}}(1+ax)^2$ the coefficient of x^2 is $\frac{107}{16}$.

Determine the possible values of the constant a. **[4]**

This part of the question was also very well answered. Most candidates were able to gain at least 2 marks for attempting three relevant terms from the product of their expansion with their attempt at $(1 + ax)^2$. While detailed methods were more common, the wording of the question did allow candidates to solve the resulting equation on their calculator, but it was only a minority that did so.

Question 9 (a)

9 Conservationists are studying how the number of bees in a wildflower meadow varies according to the number of wildflower plants. The study takes place over a series of weeks in the summer. A model is suggested for the number of bees, B, and the number of wildflower plants, F, at time t weeks after the start of the study.

In the model $B = 20 + 2t + \cos 3t$ and $F = 50e^{0.1t}$.

The model assumes that B and F can be treated as continuous variables.

(a) State the meaning of $\frac{dB}{dF}$. **[1]**

To gain this mark, candidates had to give an answer in the context of the question and many were able to do so. The most common errors were to say that it was the 'change' not 'rate of change', and to not indicate the dependency.

Question 9 (b)

(b) Determine $\frac{dB}{dF}$ when $t = 4$. **[4]**

This part of the question was very well answered, with the majority of candidates able to state the two correct derivatives and then correctly combine them. However, the modal mark was 3 as it was only the more astute candidates that appreciated that radians should be used with calculus involving trigonometric functions.

Assessment for learning

Unless the question explicitly refers to degrees then candidates should assume A Level Maths/Further Maths pure questions involving trigonometric functions will require radian measurements. Radians are much easier to use in functions, graphing and calculus.

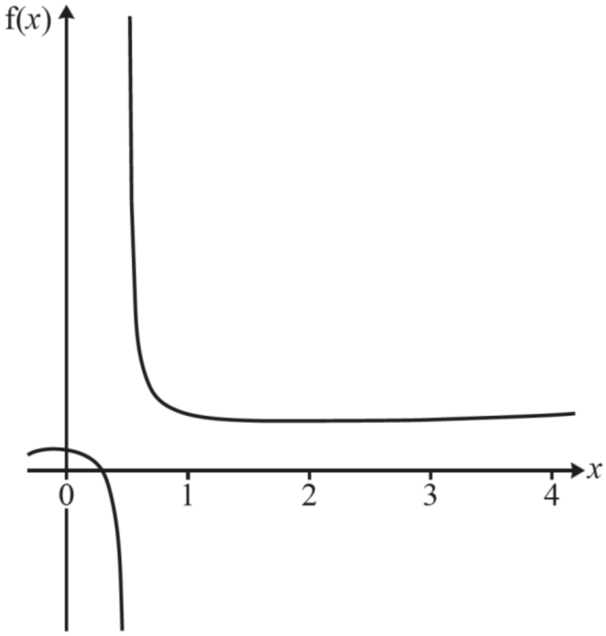
Question 9 (c)

(c) Suggest a reason why this model may not be valid for values of t greater than 12. **[1]**

Candidates needed to consider the relevance of 12 weeks in the context of this model, and identify that the change of season would be likely to affect the validity of the given model; many were able to give a sensible explanation. Some candidates simply considered the behaviour of the derivatives as t tended towards infinity. Others tried to give explanations in context, such as insufficient flowers to support the growing bee population, without appreciating the relevance of the specific value of t given in the question. When answering a question about the limitations of a model, candidates should pay close attention to how the question is actually phrased rather than giving a more generic answer.

Question 10 (a)

10



The diagram shows part of the curve $f(x) = \frac{e^x}{4x^2 - 1} + 2$. The equation $f(x) = 0$ has a positive root α close to $x = 0.3$.

(a) Explain why using the sign change method with $x = 0$ and $x = 1$ will fail to locate α. **[1]**

A variety of answers were possible; candidates could note that both f(0) and f(1) were positive hence no sign change would be seen or refer to the vertical asymptote and/or the discontinuity in the given interval. Most candidates seemed to have some idea of why the method would fail, but only a minority of candidates were able to give explanations that were suitably detailed and convincing. For example, just stating 'they are both positive' did not make clear what 'they' referred to nor reference the impact on the sign change method.

Question 10 (b)

(b) Show that the equation $f(x) = 0$ can be written as $x = \frac{1}{4}\sqrt{(4 - 2e^x)}$. **[2]**

Most candidates were able to gain at least 1 mark for rearranging as far as making kx^2 the subject of the equation. To gain full marks, the given answer had to be obtained convincingly and many candidates were able to do so. Some candidates gained the first method mark, and then jumped straight to the final answer either because they were unable to complete the proof or because they did not see the need to detail all steps.

Assessment for learning

When attempting 'show that' questions in lessons, teachers should explicitly reference the mark scheme to make sure that students are fully aware of the detail required.

Question 10 (c)

(c) Use the iterative formula $x_{n+1} = \frac{1}{4}\sqrt{(4-2e^{x_n})}$ with a starting value of $x_1 = 0.3$ to find the value of α correct to **4** significant figures, showing the result of each iteration. **[3]**

Most candidates gained full marks for being able to use the given iterative formula, showing sufficient detail in their working before drawing the correct final conclusion.

Question 10 (d)

(d) An alternative iterative formula is $x_{n+1} = \mathrm{F}(x_n)$, where $\mathrm{F}(x_n) = \ln(2-8x_n^{\ 2})$.

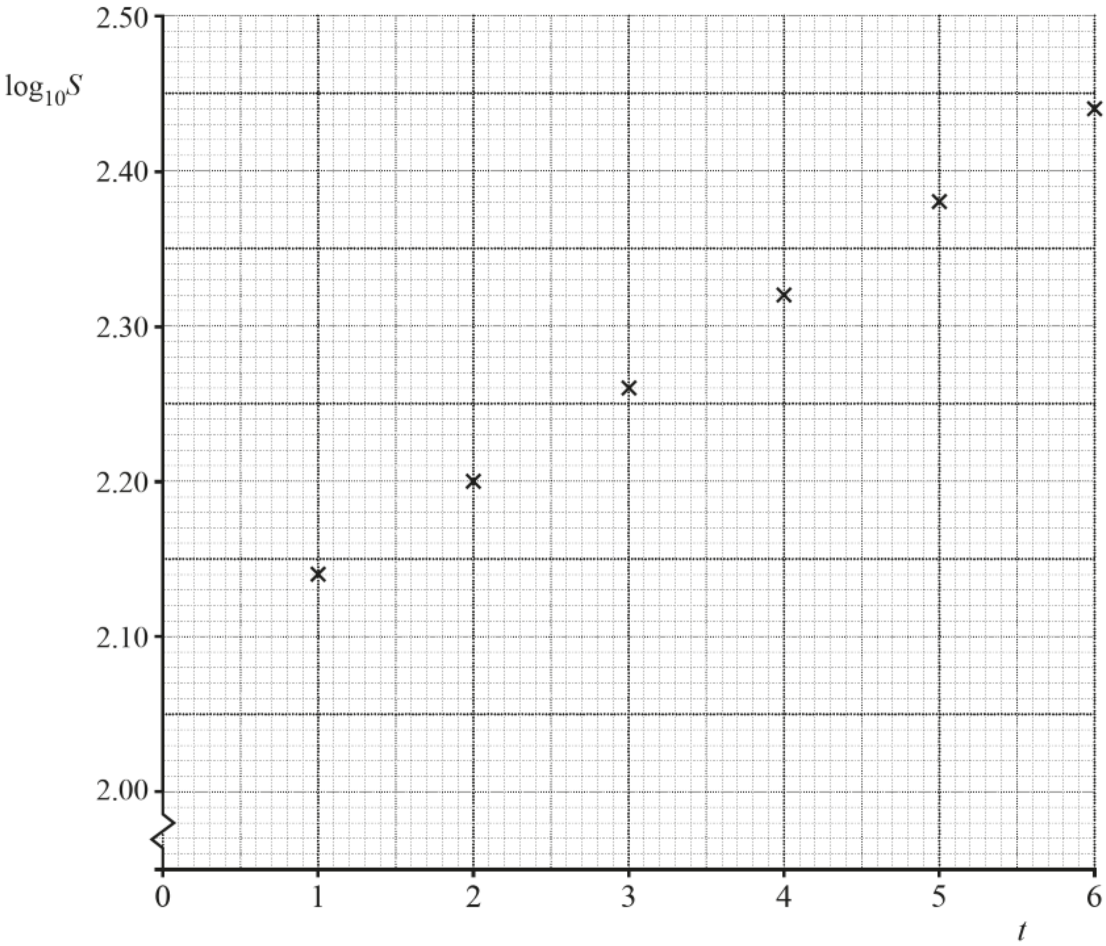
By considering $\mathrm{F}'(0.3)$ explain why this iterative formula will not find α. **[3]**

The required method was indicated in the question, and candidates were able to gain the first mark for a reasonable attempt to differentiate F(*x*). Most candidates did attempt to do this, but the derivatives were not always of the correct form. The second mark was for substituting *x* = 0.3. While a correct response can imply a correct method, that is not the case for an incorrect response; if the derivative was incorrect then candidates had to show explicit substitution for this mark to be credited. The final mark was for explaining why the value of F'(0.3) indicated divergence not convergence; some excellent explanations were seen but others thought that the fact that it was negative was the reason without also considering the magnitude. As the initial method was given in the question it was perhaps surprising that some candidates didn't even attempt differentiation, with simply using the iterative formula being the most common error.

Question 11 (a)

11 The owners of an online shop believe that their sales can be modelled by $S = ab^t$, where a and b are both positive constants, S is the number of items sold in a month and t is the number of complete months since starting their online shop.

The sales for the first six months are recorded, and the values of $\log_{10} S$ are plotted against t in the graph below. The graph is repeated in the Printed Answer Booklet.



(a) Explain why the graph suggests that the given model is appropriate. **[3]**

To gain full credit candidates had to show reduction to linear form, and relate this to the axes in the given graph. Many candidates were able to do so with sufficient detail, and others worked backwards from the equation of the straight line to show that removing logs did match the given exponential model. For less detailed solutions, there was one mark available for explaining that taking logs of an exponential model would result in a straight line. In weaker responses, candidates tended to just say that a line of best fit validated the model, without considering the axes, or gave explanations about why a business may increase their sales after opening.

Question 11 (b)

The owners believe that $a = 120$ and $b = 1.15$ are good estimates for the parameters in the model.

(b) Show that the graph supports these estimates for the parameters. **[2]**

This part of the question was generally well answered, either by relating the gradient and intercept to their linear reduction or by substituting the given parameters into the equation and then verifying that this matched the points in the graph. For the second method, evidence of substitution was required, and candidates had to verify at least two points to get both marks.

Question 11 (c)

(c) Use the model $S = 120 \times 1.15^t$ to predict the number of items sold in the **seventh** month after opening. **[2]**

The majority of candidates gained both marks for substituting $t = 7$ and then giving their final answer as an integer value. The most common errors were using $t = 6$ or attempting ($t = 7$) – ($t = 6$), despite the model being clearly defined in the first paragraph.

Question 11 (d) (i)

(d) **(i)** Use the model $S = 120 \times 1.15^t$ to predict the number of months after opening when the **total** number of items sold after opening will first exceed 70000. **[4]**

The two equally common approaches were to either equate the monthly sales to 70000 or to consider total sales, using the sum of a GP but with an initial value of 120. Only the higher scoring candidates realised that the first value in the GP should be 138, and these candidates invariably solved the equation correctly to gain full marks.

Question 11 (d) (ii)

(ii) Comment on how reliable this prediction may be. **[1]**

To gain this mark candidates had to both comment that the prediction was unlikely to be reliable, and also to give a reason why this may be the case. It had to be a specific comment, such as a competitor entering the market; no credit was given to generalities that simply said that sales may change but with no further detail. Vague comments did result in only a minority of candidates actually being given this mark.

Question 12 (a)

12 **(a)** Use the substitution $u = e^x - 2$ to show that

$$\int \frac{7e^x - 8}{(e^x - 2)^2} dx = \int \frac{7u + 6}{u^2(u + 2)} du.$$

[3]

Most candidates were able to make an attempt at this question, and the majority gained all 3 marks by demonstrating clearly how the given answer was derived. The most common errors were not showing sufficient detail when attempting the integrand in terms of *u*, and being careless with notation, i.e. the integral sign and d*u* not appearing consistently throughout.

Question 12 (b)

(b) Hence show that

$$\int_{\ln 4}^{\ln 6} \frac{7e^x - 8}{(e^x - 2)^2} dx = a + \ln b$$

where a and b are rational numbers to be determined. **[7]**

This question appears to have been very challenging for many candidates, with a variety of inappropriate integration techniques attempted. Candidates could still gain a method mark for attempting correct use of limits, but unfortunately some had given up before reaching this point. The factorised denominator should have indicated to candidates that using partial fractions would be a sensible strategy, and many did attempt to do so. The most common error was to not deal correctly with the repeated factor, but these candidates could still get further credit for integrating at least two fractions of the correct structure. However, a good number of candidates were able to provide fully correct solutions, successfully finding the partial fractions, using limits after integration and finally using laws of logs to manipulate their answer to the required form.

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Teach Cambridge

Make sure you visit our secure website **Teach Cambridge** to find the full range of resources and support for the subjects you teach. This includes secure materials such as set assignments and exemplars, online and on-demand training.

Don't have access? If your school or college teaches any OCR qualifications, please contact your exams officer. You can forward them this link to help get you started.

Reviews of marking

If any of your students' results are not as expected, you may wish to consider one of our post-results services. For full information about the options available visit the OCR website.

Access to Scripts

For the June 2023 series, Exams Officers will be able to download copies of your candidates' completed papers or 'scripts' for all of our General Qualifications including Entry Level, GCSE and AS/A Level. Your centre can use these scripts to decide whether to request a review of marking and to support teaching and learning.

Our free, on-demand service, Access to Scripts is available via our single sign-on service, My Cambridge. Step-by-step instructions are on our website.

Keep up-to-date

We send a monthly bulletin to tell you about important updates. You can also sign up for your subject specific updates. If you haven't already, sign up here.

OCR Professional Development

Attend one of our popular CPD courses to hear directly from a senior assessor or drop in to a Q&A session. Most of our courses are delivered live via an online platform, so you can attend from any location.

Please find details for all our courses for your subject on **Teach Cambridge**. You'll also find links to our online courses on NEA marking and support.

Signed up for ExamBuilder?

ExamBuilder is the question builder platform for a range of our GCSE, A Level, Cambridge Nationals and Cambridge Technicals qualifications. Find out more.

ExamBuilder is **free for all OCR centres** with an Interchange account and gives you unlimited users per centre. We need an Interchange username to validate the identity of your centre's first user account for ExamBuilder.

If you do not have an Interchange account please contact your centre administrator (usually the Exams Officer) to request a username, or nominate an existing Interchange user in your department.

Active Results

Review students' exam performance with our free online results analysis tool. It is available for all GCSEs, AS and A Levels and Cambridge Nationals.

Find out more.

Need to get in touch?

If you ever have any questions about OCR qualifications or services (including administration, logistics and teaching) please feel free to get in touch with our customer support centre.

Call us on
01223 553998

Alternatively, you can email us on
support@ocr.org.uk

For more information visit
- **ocr.org.uk/qualifications/resource-finder**
- **ocr.org.uk**
- **facebook.com/ocrexams**
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