A-LEVEL
MATHEMATICS

7357/1 Paper 1
Report on the Examination

7357
Autumn 2021

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General Introduction to the Autumn Series

This has been another unusual exam series in many ways. Entry patterns have been very different from those normally seen in the summer, and students had a very different experience in preparation for these exams. It is therefore more difficult to make meaningful comparisons between the range of student responses seen in this series and those seen in a normal summer series. The smaller entry also means that there is less evidence available for examiners to comment on.

In this report, senior examiners will summarise the performance of students in this series in a way that is as helpful as possible to teachers preparing future cohorts while taking into account the unusual circumstances and limited evidence available.

Overview of Entry

While the size of the cohort for this exam was exceptionally small it was pleasing to see that all of the marks available on the paper were achievable and some students, who had clearly prepared thoroughly, performed very well.

The average performance of students on this paper was lower than that usually seen in a year with a greater entry.

Comments on Individual Questions

Question 1

Of the four multiple-choice questions this one was answered most successfully. The most commonly selected incorrect response was $\left\{x : -\frac{7}{2} < x < 3\right\}$

Question 2

Only a minority of students selected the correct response. Almost as many students chose the incorrect $\frac{dy}{dx} = \frac{1}{5x}$. It should be noted that a calculator could have been used to check a numerical value for this question.

Question 3

This was the second most successfully answered multiple-choice question.

Question 4

This question was the least successful of the multiple-choice questions, with the most common choice being option 2.

Question 5

Around 80% of students achieved full marks for part (a) and around two-thirds made some progress with part (b).

Many students did not realise that they had to find the point of intersection of the two lines so that the correct distance could be found. The option to use a calculator to solve the simultaneous equations was overlooked by many. Students should feel confident in doing this: it is what examiners expect to see and the given equation was deliberately stated in a form which makes it easier to enter into a simultaneous equation solver.

Question 6
Most students made a good start with part (a). The most common mistakes seen were students using the formula for the sum to n terms to find the nth term and vice versa. Once both equations had been found, there was another opportunity to solve simultaneous equations on a calculator, which most chose to do by hand.

In part (b), most students were able to form an expression for the sum of the new series, but many struggled to form the equation using the sum of the series given in part (a). Once the equation was formed it could be solved on a calculator. A few very efficient complete solutions were seen.

Question 7
The first three parts of this question are very routine. For the change of sign argument in part (a), the equation given in the question must first be rearranged so that it is equal to zero, otherwise the "change of sign" is meaningless, and the argument is incomplete. Many students did not rearrange to form such an equation and were unable to achieve any marks.

A high proportion of students were successful with parts (b) and (c). For part (c) it is useful to know how to use your calculator efficiently to perform an iterative calculation. You can perform iterative calculations such as this by entering 1.5, pressing "=" and then using the "Ans" key.

$$\begin{array}{lr} 1.5 & \\ & 1.5 \\ \sqrt{\text{Ans}-1+\dfrac{3}{\text{Ans}}} & \\ & 1.58113883 \end{array}$$

All you need to do now is press "=" to get the next answer. Care should be taken to round answers to the required number of decimal places and label answers with x_2, x_3 and x_4 to avoid confusion for the examiner.

Part (d) caused difficulty for many students who often gave too many decimal places so that their interval was not of the required length. It should be clear from the oscillating nature of the values found for x_n that $1.5743 \le \alpha \le 1.5748$, so one possible interval of width 0.001 is given by $1.574 \le \alpha \le 1.575$.

Question 8
Around two-thirds of students were able to make some progress with part (a), usually using $\sin 2\theta = 2\sin\theta\cos\theta$. Progress often stalled at this point with many unable to obtain either $\cot^2\theta$ or $\operatorname{cosec}^2\theta$ by dividing by $\sin^2\theta$.

Part (b) was designed to follow on from part (a), which is why the word "hence" is used, but not all students spotted the link. It should also be noted that this question could be solved very easily on many permitted calculators. You are not asked for any justification or working, so correct answers would be awarded full marks. The same applies to part (c).

Question 9
This was a very standard piece of bookwork, so it was vital that all the steps were shown clearly,

$\log_{10}$ of both sides. Many students did not show this first step and were unable to achieve any marks as a result.

The second mark was for applying a log rule to show that

$$\log_{10} P = \log_{10}\left(A \times 10^{kt}\right) = \log_{10} A + \log_{10} 10^{kt}$$

The third mark was for a completely correct argument using another log rule to show that

$$\log_{10} P = \log_{10} A + kt$$

Note that this is a linear relationship as $\log_{10} A$ and k are constants so that $\log_{10} A$ would be the "y-intercept" and k would be the gradient, but this explanation did not need to be stated explicitly.

Part (b) was completed successfully by the majority of students.

Part (c)(i) was a "show that" question. It is important that students communicate clearly in such questions, as often the examiner is left to guess what is intended. The best solutions showed how k was being calculated, for example, $k = \frac{2.41 - 1.88}{25} = 0.0212 \approx 0.02$, which achieved full marks. Just a calculation, with no mention of k or concluding approximation, for example, $\frac{2.41 - 1.88}{25} = 0.0212$, would have achieved only one mark.

The majority of students gave a correct value for A and used it to answer part (d), but many forgot to include the correct units, namely "millions of tonnes," in their answer.

Part (e) gave another opportunity to set up an equation and then solve it on a calculator. Many students solved by taking logs, and often made mistakes.

In part (f) it was important to answer in context and to comment specifically on the global **production** of plastics. Vague or one-word answers like "Extrapolation" did not gain any credit. Only about one-fifth of students scored this mark.

A common mistake was to talk about the global production of plastics not "staying the same." This does not answer the question as the model is not based on data in which production does "stay the same."

Question 10

Part (a) was a standard use of the quotient rule. A majority of students scored at least 2 marks, with the third mark often lost through poor structure or lack of a complete argument.

Part (b) discriminated very well between students with over three-quarters making some progress, but only the stronger students realised the need to use the result given in part (a).

Question 11

This question proved to be one of the most challenging on the paper, with less than a third of students making any progress. Most did not realise they had to solve a differential equation and made no attempt to separate the variables. Of those students who did make progress, a common

$-\frac{1}{y}=\frac{x^3}{18}-\frac{2}{9}$ was often followed by the incorrect $-y=\frac{18}{x^3}-\frac{9}{2}$. A few solutions were seen where the answer was "fully justif[ied]" with a clear statement that y cannot equal zero and concluding that C intersects the coordinate axes at exactly one point.

Question 12
Question (a) was accessible to most students with around half scoring at least 3 marks. It was pleasing to see that implicit differentiation was completed successfully in many cases. It is worth noting that the question does not ask for an expression for $\frac{dy}{dx}$, so early substitution of $x=4, y=0$ makes rearranging much easier:

$$2x+2y+2x\frac{dy}{dx}+2y\frac{dy}{dx}=4\frac{dy}{dx}+2$$

becomes

$$8+0+8\frac{dy}{dx}+0\frac{dy}{dx}=4\frac{dy}{dx}+2\Rightarrow 4\frac{dy}{dx}=-6$$

Part (b) was designed to be answered even if errors had been made in part (a). The A1F indicates that you could obtain both marks following through an incorrect x value from part (a). It is, therefore, important that working is clear so that the examiner can follow how a solution is obtained. Some students only scored 1 mark as they did not rearrange their equation into the required form.

Question 13
Over three-quarters of students made progress with part (a) and demonstrated that $P\left(-\frac{1}{5}\right)=0$, but little over a third scored full marks. Most either made an incomplete concluding statement or got it the wrong way around, eg writing $(5x+1)$ is a factor of $P(x)$ implies $P\left(-\frac{1}{5}\right)=0$

Part (b) was completed very successfully with most students scoring full marks, although many students overcomplicated this part, using algebraic long division. All permitted calculators will solve a cubic equation which should enable you to simply write down the answer, using the factor theorem again.

As expected, part (c) was very challenging. While a fair number of students realised they could use the result from part (b) to factorise, giving $250n^3+300n^2+110n+12=2(5n+1)(5n+2)(5n+3)$, very few students were able to make any further progress.

Question 14
Part (a) was quite accessible, with three-quarters of students making some progress. A common mistake was to try to eliminate t from the parametric equations and students who took this approach were unsuccessful.

In part (b) many students seemed unfamiliar with the idea of finding the area under a curve defined parametrically. The “show that” question in (b)(ii) was often attempted with little success due to poor use of notation and a lack of a clear structured argument.

The final part, (b)(iii), was intended to be accessible even if errors were made in the rest of the question. The integral given in (b)(ii) simply needed to be evaluated on a calculator.

Question 15
Part (a) was very accessible, with nearly 60% of students scoring at least 2 marks. The third mark was often lost through a lack of structure or unclear working. To achieve full marks the argument needed to start with $\sin x - \sin x \cos 2x$ and clearly demonstrate that it is approximately $2x^3$.

Around 40% of students understood that they had to form an integral for part (b) and of those who did, most made good progress. Writing the final answer in the correct form proved to be very challenging, with few students achieving the last mark.

Part (c) was intended to be challenging: while some mentioned small angles, answers were often not specific enough and did not refer to 6.3 or 6.4 as not being small.

Concluding Remarks

When compared with previous papers, the marks available are accessible and the level of difficulty of the questions is broadly comparable despite the lower overall attainment.

Areas of the specification where students performed particularly well include coordinate geometry, application of arithmetic sequence formulae, iterative solutions of equations, modelling with exponentials and factorising polynomials.

It was particularly noticeable in this series that students seemed reluctant to make full and effective use of their calculators. This is an important and useful resource, which can save a lot of time when used properly. Students should feel confident that they will receive full credit for solving equations on their calculators when they are simply asked to find an answer. More detailed working is required if the question requires something to be shown.

Throughout this paper, students often lost marks in “show that” style questions through a lack of attention to detail, omission of a clear starting point and/or conclusion, and poor or inconsistent use of notation or mathematical symbols.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.