A-LEVEL
MATHEMATICS

7357/1: Paper 1
Report on the Examination

7357
June 2019

Version: 1.0

General Comments

This paper provided the opportunity for all students to demonstrate their knowledge and skills, with the full range of available marks being scored.

It is encouraging to see many students giving clear and relevant justifications for steps in their arguments when required. However, a significant number did not seem to realise the importance of the standard phrase 'Fully justify your answer', which not only means show clear working, but is a clear indication that a step needs to be explained or justified.

It was evident that some students were still reluctant to use their calculators to cut down the amount of work required. It should be noted that if a question simply requires an answer to be *found*, rather than *shown* or *justified*, then calculators can be used with confidence to solve equations, solve simultaneous equation or evaluate expressions.

Question 1 (Multiple choice)

This question was answered correctly by the vast majority of students, although a significant minority selected $-2\log_{10}\left(\frac{1}{a}\right)$, with the next most popular wrong answer being $2\log_{10}(a)$.

Question 2 (Multiple choice)

This was the most successfully answered multiple choice question, with only a very small number of students who chose an incorrect option. The most frequently chosen incorrect answer was $\frac{dy}{dx} = kxe^{kx}$, with the other two incorrect answers being chosen in roughly equal proportion.

Question 3 (Multiple choice)

The majority of students selected the correct answer. The most frequently chosen incorrect answer was $12.8\,\text{cm}^2$, followed by $3.2\,\text{cm}^2$.

Question 4

This question was answered well by most students. Almost all students found the correct gradient for a perpendicular line and used it to form an equation.
The most common mistake made by students was in finding the mid-point. Often the coordinates were subtracted rather than added.

Question 5

Nearly all students scored full marks on part (a), which was intended to help students get started with the question and give a hint as to what was required for part (b). Those who dropped a mark usually had insufficient working to *show* the given result.

Part (b) discriminated well between students: while many were able to form a second equation, mistakes were seen when students were solving their two simultaneous equations to find the first term and common difference. Often, students produced unnecessary working when the equations could easily be solved on their calculators.

Fewer students scored well on part (c). While some students correctly explained that all the terms of the sequence were negative after term 41, so the sum would be decreasing from then on, very few mentioned the fact that all the previous terms were positive, so the sum would be increasing. Some students used language which was too imprecise, mixing up nth term and sum to n terms.

Question 6

While most students got 6(a) correct, a significant number did not. Often the mark was not gained because of the incorrect use of notation. Students need to know how to use set notation correctly.

In part (b)(i) students were generally very successful in rearranging to obtain the first two marks, but only a very few remembered to give the domain of the inverse function.

Students were less successful in (b)(ii) than in part (a). There were three main causes of error: incorrect notation, use of a strict inequality or use of a lower bound other than zero.

Around half of the students knew that the graph of a function and its inverse are reflections of each other in the line $y = x$.

Most students formed a correct equation for part (d), but many made heavy going of solving their equation. As the question only required students to find the answer, use of a calculator to solve their equation was perfectly acceptable.

Question 7

Nearly all students made some progress with question (a), however many lost one or two marks through a lack of attention to detail when sketching the graph of $y = \sec 2x$.

In part (b), the change of sign argument required relies on the equation being rearranged to the form $\mathrm{f}(0) = 0$. Students who missed this step were penalised as without this step the change of sign method is meaningless, no matter how well it is done.

Around three-quarters of students made some progress with part (c), achieving at least one mark for the correct use of $\sec 2x \equiv \dfrac{1}{\cos 2x}$. Many went on to rearrange to show the given result, although there was a significant number who could not handle the inverse correctly.

Part (d) was a very routine question. A very high proportion of students used the iterative formula they were given to obtain two marks in (d)(i). Students should know that in a situation like this they must work in radians. Most students produced the required cobweb diagram for (d)(ii), but some lost the second mark for not labelling their x_2, x_3 and x_4 in the correct position, clearly linked to the x-axis.

Question 8

Most students obtained the correct values for part (a) although some made heavy going of it. This was an opportunity to simply evaluate on a calculator.

Having done part (a) it was intended that students would be able to spot that $P(n)=n^3$, which many did, but this proved too difficult for a significant number of students.

Several attempts were seen where students used standard formulae learnt in further maths, but this led to far more than two marks' worth of working. Those who tried this approach often gave up.

Question 9

This question proved to be very demanding for the less able students. A significant proportion of students failed to realise that they should be using proof by contradiction and made no progress. The first mark was effectively awarded for any reasonable attempt at contradiction so students needed to be able to select an appropriate method of proof for the given situation.
The full range of available marks was achieved by those who knew which method to use. Some excellent, fully correct solutions were seen.

Question 10

This was a relatively straightforward example of a connected rates of change question, but one which discriminated well between students. While many very efficient and fully correct solutions were seen, for others translating the first sentence of the question into an equation of the form $\frac{\mathrm{d}V}{\mathrm{d}t}=k$ was a stumbling block. Following this difficulty, students usually only picked up one mark for differentiating the given expression for volume and incorrect notation then made it more difficult for them to combine rates of change using the chain rule.

Question 11

Differentiation from first principles is one of the new topics included in this specification, and demonstrating an understanding of this technique is reliant on the use of correct notation to show the limiting process being used. The majority of students made some progress, correcting $h=0$ for $h\to 0$ or showing an understanding that $\lim_{h\to 0}\frac{\sin(h)}{h}=1$.

Question 12

Part (a) should have been very routine and any student who had learnt the trigonometrical identity $\cot^2 x+1=\operatorname{cosec}^2 x$ usually completed this part very efficiently. A significant number of students wrote $\cot x$ and $\operatorname{cosec} x$ in terms $\sin x$ of and $\cos x$, but this often led to numerical slips or, in some cases, insufficient progress was made to be worthy of any credit.

In part (b), the question specifically asked for a fully justified, exact value, so students who adopted a numerical approach were unable to make progress in this question.

The majority of students solved the quadratic equation to find exact values for $\operatorname{cosec} x$ or $\sin x$ and, of these, many went on to obtain the correct exact magnitude of $\tan x$. However, few scored full marks and students need to be aware that the phrase 'Fully justify your answer' usually means that there is something that needs to be explained. In this question, students needed to say why they were rejecting one of the solutions to the quadratic in $\operatorname{cosec} x$, with specific reference to the allowed range. Most students missed the fact that x was obtuse making $\tan x$ negative.

Question 13

Over 90% of students made some progress with this question. Many demonstrated that they realised the quotient (or product) rule needed to be used.

Again, 'Fully justify your answer' required students to explain what they were doing, which some did very well. It is a standard expectation that students should explain that stationary points occur when $\frac{\mathrm{d}y}{\mathrm{d}x} = 0$ and why possible solutions to equations are rejected. Several students attempted to show things that weren't required, such as the nature of the stationary point or its y coordinate.

Question 14

Many students in part (a)(i) forgot the relationship between the number of trapezia used and the number of ordinates required, but the majority answered correctly.

Part (a)(ii) should have been routine but there were lots of numerical slips seen. While the majority made some progress, less than half of the students scored full marks.

The integral required for part (b) was often attempted using integration by parts. This method is very inefficient here and many students who tried it did not make enough progress to score any marks. It was clear from the solutions to this question that students had not generally spent enough time practising how to recognise when a substitution is appropriate, or what type of substitution might be useful.

In part (c), students were required to show an understanding that the limit of the trapezium rule would be equal to the value of the integral calculated in part (b). Too often students wrote generic answers such as 'It will get more accurate'; such statements, which can apply to many questions, will not usually be specific enough to gain credit.

Question 15

This question was primarily about using and interpreting a model. There were no requests to justify or show anything, but many students did much more work than required.

Part (a)(i) was completed successfully by the majority of students. Simply evaluating the height formula at $t = 0$ was all that was required.

Most students made good progress with (a)(ii), setting $v = 0$, but many went wrong solving the resulting quadratic and should, perhaps, have made better use of their calculators. Some who found the correct value of t forgot to convert this into a time.

Almost three-quarters of students achieved the mark for (a)(iii). 'Follow through' was applied so that, provided a student showed they were using their value of t from part (a)(ii) correctly, they could get this mark.

Part (b) was overcomplicated by the majority of students. Most realised they needed to find the value of t for maximum v, but few did this efficiently. The most frequently seen method was to differentiate, but this often led to errors which meant full marks could not be awarded. The most able students recognised that the formula for v was a quadratic which was written in completed square form so the value of t could simply be stated.

In part (c) most students wrote statements about tides, weather or climate change rather than criticising this specific model. This might indicate that students need to practise criticising mathematical models.

Question 16

This question was intended to be more demanding and, while many students made good attempts at parts of it, only a small proportion gave completely correct solutions.

Around three-quarters of students made good progress with part (a), scoring at least 2 marks, with most students going on to score full marks. A significant number of those who differentiated correctly were unable to rearrange correctly.

The instruction in part (b) included the word ‘Hence’. Students should be aware that this is a clear instruction that they should use the result from part (a) in some way. The question was testing understanding of the fundamental theorem of calculus, so students who used integration by parts did not score any marks.

Finding the required area in part (c)(i) involved using the result from part (b). Even if students had not got part (b) correct they could still be awarded follow through marks, provided their working was clear. As the question required an exact value, no credit was given for evaluating the integral using a numerical calculator approach.

Part (c)(ii) was a ‘Show that’ question, so it was particularly important that students’ working was clear. Of those who used the correct limits to evaluate the integral for A_2 some did not realise that they should remove the minus sign, ideally explaining why. Other students did not do enough to show how the fraction they had formed simplified. As the answer was given, the numerator should have been factorised to show how cancelling could be achieved.

The last part of the question required students to put together what they had found so far, or use the results they had been given. The key to part (c)(iii) was spotting that the areas form a geometric series and the required area could be found using the sum to infinity. As the answer was given, it was again important that working was set out clearly to show how the sum simplified.

Mark Ranges and Award of Grades

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