A-LEVEL
MATHEMATICS

7357/2 Paper 2
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

The entry was much smaller than for a normal summer series and the cohort appeared to be overall somewhat weaker than normal. Nevertheless, algebraic skills were generally sound, and the early pure mathematics questions were well attempted. In question 9, sorting out the required geometry proved challenging. In the mechanics section, question 17 on differential equations and question 18 on projectiles were often poorly attempted. However, other mechanics questions yielded more positive results.

Comments on Individual Questions

Section A

Question 1
Surprisingly, only around a third of students correctly answered this question. The most popular incorrect answer was C. No option was left unchosen.

Question 2
This question was answered a little more successfully than question 1 with just under a half of students answering correctly. The most popular incorrect answer was option 2. No option was left unchosen.

Question 3
This was the most successful of all the pure multiple-choice questions with around half answering correctly. The most popular incorrect answer was option 1. No option was left unchosen.

Question 4
This question proved more successful than on previous occasions when the modulus function has been tested. In part (a) most students were able to draw a V-shaped graph, with the apex on the x-axis. Some students placed the apex on the negative x-axis and scored no marks. No penalty was given for incorrect coordinates of the intersections with the axes. In part (b), students were often able to find at least one solution originating from $3x – 6 = 2x$. Most students preferred to solve the linear equations, with the option of squaring rarely seen; this was a significant change from previous questions on the same topic. Around half of students were able to find both solutions.

Question 5

This question was well done with over two-thirds of students scoring full marks. In general, when a mark was lost it was for a slip up in substitution of values, resulting in an incorrect value of A or B. A handful of students attempted to obtain algebraic expressions for A and B, not recognising them as constants.

Question 6

This was another successfully answered question with students able to show that they understood laws of logarithms. It was good to see students clearly obtaining the line $x(\ln 5 – \ln 3) = \ln 81$, or similar, before then obtaining the printed answer. Those students who were not proficient in the laws of logarithms often scored the B1 mark for recognising that $4\ln 3 = \ln 3^4 = \ln 81$, at some point. Note that to score the final R1 mark, brackets must have been used correctly in the second line of the solution, so $x\ln 5 = (x + 4)\ln 3$ rather than $x\ln 5 = x + 4\ln 3$. If logarithms to any other base were used throughout then all four marks could still have been awarded for a comment explaining that the result would be true for any base of logarithms at the end.

Question 7

Question 7(a)(i) was very well done with over three-quarters of students stating the correct centre (3, 4). Incorrect answers that were otherwise seen were (-3, -4), (6, 8) and (-6, -8).

Question 7(a)(ii) was generally also done well with most students obtaining the first mark, showing that they knew how to obtain the standard form of the circle. Around half scored all three marks. Incorrect answers seen were $p + 25$, $\sqrt{(p – 25)}$ or $\sqrt{p} + 5$. However, if the correct answer was obtained at any point, incorrect working after that was ignored.

Question 7(b) proved the most discriminating part with very few students able to obtain the two correct values of p. As this was a problem-solving question, the first mark could have been obtained for sketching an appropriate circle satisfying the condition required or recognising that $x = 0$ or $y = 0$ could be substituted to obtain an equation for p. As such, the majority scored at least the first mark. In the tangent case it was good to see students using the discriminant, without prompting, to solve the problem. This was the more popular case to consider and more students obtained $p = –9$ than $p = 0$.

Question 8

This question indicated that there is still a lot of work to be done on understanding proof. Around 60% scored one mark in part (a), but less than a quarter of those were able to obtain both marks. The more popular error to be identified related to the incorrect expansion of the bracket. A significant number of students were distracted by focusing on the factorising part and commenting that ‘3’ had not been taken out of the first bracket correctly, thus not realising it had come from the second bracket. The second mark could have been scored for stating that ‘all possibilities had not been exhausted’ or by identifying the missing case.

In part (b) around half the students corrected the expansion of brackets error but often no further marks were scored. Students who did realise that they had to consider either $3m + 2$ or $3m – 1$ were very proficient and usually went on to score all four marks. It was also good to see the proof being concluded with a clear statement.

Question 9
This question presented a significant challenge. Many left different parts completely blank. Very few students were able to score in part (a). The first mark was a very generous mark awarded for identifying or using an appropriate horizontal distance, usually d$\cos\theta$. Students should be encouraged to use and mark the diagram to help them solve the problem: those that did often scored at least one mark. Part (b) proved the most successful part with around 20% scoring both marks, showing an understanding of the identities required. Slightly fewer scored both marks in part (c) with incorrect arguments often relating to the maximum value of $\cos\theta$ being 1. Part (d) was perhaps the most disappointing response with students not realising it was essentially a cosine rule problem. Indeed, where attempted, the sine rule was often chosen to little avail.

Question 10
It was pleasing to see students usually able to identify the two parts of the domain. However, $x > 0$ was more often seen than the correct $x \geq 0$. Attempts at set notation were better, but marks were still lost for not using curly brackets or not using ":"appropriately. Unfortunately, some correct uses of set notation had errors such as "$x > 0$" and so scored only 2 marks. Some students did not understand that the domain of a function is a set and that simply stating the valid values of x is not sufficient to correctly define the domain.

In part (b) it was clear that students had an idea about discontinuities, but they often did not make specific reference to either $x \neq 3$ or the fact that 3 lies in the interval $1 < x < 4$. Both comments had to be made to score two marks.

Part (c) proved very challenging, and no one managed to score the full six marks. A number of students saw the reference to inverse and started to try to make x the subject, ignoring any aspects of calculus that were required. Of those who did differentiate, typical errors were:

- wrong signs in the numerator
- wrong powers in the numerator
- when using the product rule, differentiating $(x - 3)^{-1}$ as $-(x - 3)^0$

Students were then well drilled and set their expression equal to 0, but the algebra required to solve such an equation was beyond them.

The E1 mark was awarded for realising that a continuous function with no stationary points must be one-to-one and so the inverse exists. This mark was for a general comment relating to one-to-one functions rather than this specific function. The final R1 mark proved unattainable by all students.

Section B

Question 11
This was more successfully answered than the earlier multiple choice questions with about two-thirds of students answering correctly. The most popular incorrect answer was option 3. No option was left unchosen.

Question 12
This was the most successful of all the multiple-choice questions with about 75% answering correctly. The most popular incorrect answer was option 1. No option was left unchosen.

Question 13
This was a very successfully answered mechanics question with about 75% of students scoring all three marks. If a mark was lost it was largely due to finding an incorrect value for acceleration. However, using $F = ma$ correctly with their value of a could still score the final mark.

Question 14
This was a successfully answered question with students realising that they had to calculate the area below the graph. There were many ways to do this: using rectangles, triangles, trapezia or counting squares.

Marks were lost for the following reasons:

- using values of t outside the interval given
- dividing the required area into too few polygons
- double-counting some areas
- failing to compare directly with 130
- failing to state that Noosha was correct.

Question 15
This was meant to be a relatively straightforward question on connected particles. However, full marks on any part were rarely seen. In part (a) many wrongly included the driving force in their calculation and others did not provide a suitable reason: that at constant speed there was no acceleration and therefore no resultant force. In part (b) the acceptable assumption had to focus on the rod being rigid, inextensible or perfectly horizontal. Note the requirement for an assumption made by the student, so stating one already in the question scored no mark. The final part was more successfully answered although a mark was often dropped for not including units. In this part it is important to state a clear equation first e.g. $T + R = 40$

Question 16
The use of moments was much improved, and many students were able to at least begin to form a suitable equation. Many took moments about the point of suspension, with moments about *B* being popular too. Marks were lost for the following reasons:

- a mixture of moments about two different points in one equation
- using Wg rather W
- using an incorrect expression for tension if moments about *B* were taken

The question was usually completed well and the final printed answer was usually justified by factorising first as in the typical solution on the mark scheme.

Question 17
Part (a) was generally well answered with about 60% scoring both marks. The R1 was lost for not clearly stating all the values before substituting them into a correct constant acceleration equation. Attempts that scored 0 made no use of such equations.

Part (b) was extremely challenging with very few realising that a differential equation needed to be formed and solved. Students need to be aware that these types of questions cannot be solved using constant acceleration equations. Even when the differential equation was recognised there were very poor attempts at separating the variables or even integrating with respect to the correct variable.

Part (c) proved more successful with almost half scoring one mark, usually for recognising that in the first model the velocity would increase continuously. It was pleasing to see students display their knowledge of terminal velocity even if part (b) had proved beyond them. In some cases students could have improved their answer by being clearer on whether they were talking about Amy's model or Andy's model.

Question 18

This proved to be the most challenging question on the paper, with many students not attempting parts of it. In part (a) many students struggled to write down any appropriate equation of motion either horizontally or vertically. A very generous first mark allowed students to score one mark if a correct component of velocity had been stated.

Part (b) was slightly better answered, especially if students used the printed answer in part (a) to find a value for θ and then used this and $t = 0.4$ in an appropriate equation. Those using the horizontal components were usually more successful than those who used the vertical components.

It was disappointing to see many not able to provide an appropriate assumption in part (c). Many left it blank or stated an assumption already given in the question.

Question 19

In part (a)(i) the mark could only be scored for referring directly to 'scalar multiple' or by a correct reference to and use of algebraic vectors. Too many students incorrectly referred to 'factor' or the imprecise 'multiple'.

Part (a)(ii) was more successfully answered, and it was good to see different ways of verifying the result. The most popular was to substitute $k = 0.8$ in Amba's velocity then show that the magnitude was 8. Others formed an appropriate equation with k and then solved it to show $k = 0.8$.

Part (b) was more successfully answered than in the past with the first mark scored by almost half, who correctly found the displacement vector. However, many did not then realise how to use the initial position vector to obtain the correct answer.

Part (c) was rarely answered correctly. However, an odd mark could be picked up for finding an appropriate speed or distance. Sketching a trapezium was the key to solving the problem. Note that to score full marks here, the solution had to be clearly developed and shown. No marks were awarded for an unjustified '3 metres'. Too many attempts tried to use position vectors of some description.

Concluding Remarks

Students generally performed better on the pure section than the mechanics, with questions 17 and 18 proving particularly costly for many. These questions were difficult, but it was nevertheless disappointing to see so few make any inroads at all.

Mark Ranges and Award of Grades

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