AS

Mathematics

7356/1

Report on the examination

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General

The standard of responses from students overall continues to improve, reflected in a further rise in the overall mean marks achieved.

The multiple choice questions at the start of this year's paper proved straightforward for most students.

There were some excellent responses to what would be considered demanding questions, such as questions 10, 13 and 21, which cover parts of the specification that normally prove challenging for AS students.

Students also responded well to some less familiar types of question, such as question 6, 7(b) and 12.

Some common areas remain challenging, particularly trigonometric equations as in question 4, and some aspects of mechanics in questions 17 and 18.

Students should be reminded of the significance of how questions are worded, and the requests used, so that they are able to respond accordingly, providing detailed solutions where necessary and making more use of calculator functions when appropriate.

Questions 1

As expected, basic knowledge of the $\tan\theta$ identity was secure, with almost all students choosing the correct answer in the first question.

Questions 2

There were slightly more incorrect responses to question 2, which might be expected as a logarithm-based question. It is worth reminding students that in simple applications such as this, substituting a value for b would enable them to quickly obtain the answer from a calculator.

Question 3

The factor theorem is usually a topic that students are confident with, and responses reflected this. It is important that students understand that when they are directed to use a specific method to answer a question, any attempts outside of this approach are unlikely to receive any credit. Inevitably, some attempted to use algebraic division, with little success.

Typical errors involved numerical, or sign slips after substituting 2 and the occasional substitution of –2, but a large proportion of students were able to gain full marks very efficiently.

Question 4

As a fairly routine trigonometric equation, it was perhaps surprising that only around half of students were able to gain full marks.

Most errors involved dividing by 3 at an incorrect stage in the question: some divided by 3 prior to obtaining the principle solution and therefore scored 0 marks, while others did so immediately after obtaining the first solution and so were limited to 1 mark if they then followed the usual method of adding 180°.

A small number of students followed the correct approach but only obtained two solutions, this was because they had not fully accounted for the adjustment in the range and defaulted to finding solutions up to 360°.

Only a minor number of responses recognised that the request of the question permitted the use of calculator functions and stated the three correct values with no working to obtain full marks. That said, there were some very good responses with clear working shown from those that had a good grasp of the required skills.

Question 5

Many students were able to obtain 2 marks, having realised the requirement for at least one of a or b to be negative and presenting a clear solution. A minority omitted some form of comparison of their result with 1 which was required to complete the demonstration and so only achieved 1 mark. A common incorrect response was to use $b = 0$, which did not produce a valid counterexample, while others used a value of b between 0 and 1 or started from values where $a < b$ but proceeded to state that they had demonstrated a counterexample.

Question 6

This was a slightly different form of logarithm question compared with previous series, so it was good to see a lot of correct responses to part (a) from students that had a good command of the basic application of logarithms and almost two-thirds of students were awarded 2 marks. The most common incorrect response scored 1 mark following the correct separation of the terms before then giving the answer $p^2 - q$.

Part (b) proved far more challenging as it became clear that many students did not have a good grasp of using the power law with multiple terms inside the log function. The mark available for recognising the need to rewrite $\sqrt{y}$ as $y^{\frac{1}{2}}$ was scored by a lot of students, but for many they were unable to score any further marks after incorrectly writing $3\log_2 16x$ as part of their solution. The very small proportion that obtained 2 marks tended to either leave the constant term as $\log_2 16$ or incorrectly substitute p and q in some way.

Question 7

Part (a) was a simple mark for most that simply stated the correct radius of 7. It should be noted that in cases such as this where the answer is an integer, it is expected that any expressions are evaluated and therefore $\sqrt{49}$ as a final answer will not be credited.

Part (b) was a good discriminator between students. The most able recognised the significance of how b would determine the position of the circle and therefore the intersections with the x-axis, and simply stated a correct inequality, sometimes with the aid of a simple sketch.

A large proportion of students clearly linked the idea of points of intersection with the discriminant based on previous questions and began forming quadratic equations to then find the discriminant. While this approach could of course obtain the correct result, algebraic errors were common and so it was rare to see this approach score any marks despite extensive time and effort spent on solutions.

Question 8

Graph sketching often proves challenging for students, but there were some excellent curves seen that were certainly worthy of full marks. Weaker answers could still score well as marks were available for demonstrating various aspects of the curve, including the correct shape and orientation, and the repeated root. Many could have scored full marks for an excellent sketch but had errors in the labelling, typically omitting the minus sign from $-2k$ or a label of $2k^2$ on the y-axis. Non-cubic graph shapes were rare but were unable to score any marks.

Question 9

Part (a) was a routine request for some terms from a binomial expansion and was well answered by the majority of students, the most common error being the omission of the minus sign from $-35x$

Given that part (b) was a fairly standard follow up question to a binomial expansion, responses were poorer than might have been expected. While most recognised the link with part (a), a notable proportion of students only considered one of the relevant pairs of terms (usually $-35kx$) and would therefore only obtain the first mark. Those that did consider both pairs of terms generally went on to score full marks, with sign errors the most common slip for those that did not.

Question 10

There were some excellent responses to question 10, that worked very efficiently through the required steps to obtain the correct answer, which was often given in an exact form that demonstrated excellent knowledge of logs (although this was not explicitly required in this case). This is a significant improvement over previous questions.

Weaker answers had the typical errors that might be expected in a question like this: confusion between tangent and normal, not being able to recall the derivative of e^{3x} (with $3xe^{3x}$ being the most common error), and incorrect log work from a correct equation. While students are only required to recall the derivative of e^{kx} at AS-level, it is an important result that can limit access to certain questions if not known.

Question 11

The early parts of question 11 proved very accessible, and students seem to have a better understanding of what is required in a 'show that' type question such as part (b). When answers are given, students must expect to demonstrate the required steps, which in the case of integration, includes the substitution and evaluation of limits. Over half of students were able to show all required working and achieve 4 marks.

Part (c) tested the understanding of integration and gave stronger students the opportunity to demonstrate their knowledge. The majority of incorrect responses to part (c)(i) referenced negative area in some way, which as a mathematically problematic idea was awarded 0; in some cases, this was part of what would have been an otherwise acceptable explanation. Many students also misunderstood the request and explained how they would find the total area, rather than why 36 was not the correct area. These responses effectively gained credit in part (c)(ii) if they were able to carry out their method correctly. Overall (c)(ii) was better answered than (c)(i), which suggests that although students may know how to calculate the total area when it is both above and below the x–axis, they don't necessarily have a clear understanding of why it is necessary.

Question 12

Use of factorials has not been frequently tested, but there were some good responses. As it is not frequently used, it is worth reminding students of what is included in the formula booklet as part (a) was easily answerable using the given formula.

Part (b) proved more challenging, with many responses opting to simply type the expression into a calculator and quote the answer, which scored 0 marks. The direction to use the result from part (a) meant that some sort of related method had to be demonstrated, which could simply have been a fully correct multiplication or division sum with the relevant factorials. It is clear from some responses that many students have a very good understanding of how to manipulate factorials. While it may seem a minor point, it is worth noting that the request to show that the answer could be written as $\frac{23}{q}$ means that students should be aiming to reach $\frac{23}{18}$ not stating that q = 18; this would have been the answer to the request would be 'Find the value of q'

Question 13

This style of modelling question has been tested consistently since the start of the new AS specification, and it is clear that student responses are continuing to improve, and it was not uncommon to see a student work through the whole question correctly to obtain 9 marks.

Most students recognised the interpretation of the value of A but as is often the case, a number of responses lacked any context, talking generally about the 'initial value' or similar. Many students were well rehearsed in demonstrating the transformation of an exponential model to a linear form using logs in (b) and understood the link between the given straight line and model parameters in (c). Common errors in part (c) were stating A = 5.3 and obtaining the correct values but with A and k the wrong way round. Those that had correct values for A and k were frequently able to score full marks in (d), while weaker answers could still gain a mark for setting up an equation using their values from (c).

Section B Mechanics

Question 14

Many students made a good start to section B with a straightforward application of F=ma in question 14.

Question 15

Question 15 proved more challenging but was still answered correctly by more than half of students. Incorrect responses to 15 were equally split between the third and fourth options, identifying an incorrect pair or that none of the forces were parallel.

Question 16

The majority of students were able to correctly calculate the speed from the given diagram, with a lot simply stating the correct answer of 2.4. Incorrect responses were typically based on finding the area, confusing this approach with finding displacement from velocity-time graphs.

There were some excellent sketches drawn in (b), clearly understanding how starting from rest would impact the shape of the graph. In this case, the request to draw a 'more realistic' graph, meant that curves convex at the origin could be credited. While there will always be some degree of tolerance on graph sketches, those that clearly missed the point (5,12) did not receive credit as it was specified the car travelled 12 metres in 5 seconds.

Question 17

As a routine application of Newton's second law, it was perhaps surprising that fewer than half of responses were able to achieve both marks. Given the requirement for a three-term equation of motion, those that wrote R = 60g or similar scored 0 marks. Responses that only scored 1 were usually due to a sign error when setting up the original equation, leading to 516N as the most common incorrect answer.

Question 18

The full range of marks were scored in question 18 as sign errors continue to be a major obstacle for many students when setting up equations of constant acceleration. While there are many different combinations that could be correct based on the variety of approaches that could be considered as being valid, it must be a consistent set of values used in order to gain full marks.

The added complication of starting and finishing at a different level did cause some issues, with some subtracting 1.8 in their final step. Those that attempted to deal with this as part of their initial equation were not penalised as both $h + 1.8$ and h – 1.8 were accepted in the first step.

Question 19

Around half of students were able to score full marks after setting up a correct Pythagorean equation. The minus sign was allowed to be ignored or omitted from calculations but those that wrote $p^2 + -0.5^2$ or similar as part of their equation were limited to 1 mark unless they clearly recovered the required brackets before further processing.

There were a variety of errors that prevented responses from gaining full marks; incorrect combinations of distance formula and 1.3, for example $p^2 + 0.5^2 = 1.3$ and $\sqrt{p^2 + 0.5^2} = 1.3^2$, errors when rearranging their equation, and the omission of the $\pm$ sign at the final stage. In the latter case, it is worth reminding students that questions will not be worded in a way so as to 'catch them out,' so where the request is to find the possible values for p, there will be more than one solution to be found.

Question 20

As the longest question of section B, this proved to be a good source of marks for a lot of students. The first part was well answered with the majority of students able to quote the initial speed of the model, although some ignored the reference to the model and stated the initial speed would be 0, which would instead have been a valid comment for the final part. Similarly, most could recall the requirement to differentiate to find the acceleration for the model in (b)(i), with a minority incorrectly choosing to integrate instead.

Part (b)(ii) proved to be a greater challenge for many. Despite the attempt to guide students towards the method through part (b)(i), it was not unusual to see attempts based around suvat, which clearly never made any progress. For those that recognised the correct approach, calculation errors were the most common reason for students to lose marks.

As is typically the case with mechanics questions requiring comments, there were a wide range of responses to part (c). Many students identified that the model was not very accurate but justified this by simply stating that 16.24 was greater than 12. It is highly unlikely any model is going to produce the true value, and it is therefore the scale of the difference that is the key point of consideration. Acceptable responses included '16.24 is significantly greater than 12.4' or calculation of the percentage error, along with a statement that the model was therefore not accurate. Most responses focused on the 12.4 given in this part, but it was equally valid to explain that the initial speed of 1.8 was also unrealistic given athletes would start from rest.

Question 21

Overall responses to the final question seemed to have improved from last year. As previously stated, it is expected that such questions will be solved by forming an equation of motion for each particle, and there certainly seemed to be fewer students attempting to write a single equation for the whole system. A significant number of students could have scored full marks but made the unexpected errors of either not leaving answers in terms of g as directed, or for finding a correct expression for a or T, only to then make a simple error in their use of fractions to find the other expression. Many students that made a sign error in their initial equations were able to progress correctly and achieve 3 marks.

Part (b) asked students to identify the limitation of modelling the buckets as particles. As tends to be the case, the majority of students made comments about air resistance, while others made comments about hitting the pulley or surface following last year's question, but this was not relevant in this context. Ultimately, modelling objects as particles means that their dimensions are not considered, while buckets would clearly have dimensions, which was sufficient to gain the mark as the precise implication of this may not be clear. Correct responses were rare, but some did mention that the buckets may collide with each other if their size was taken into consideration.

Mark Ranges and Award of Grades

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