AS
MATHEMATICS
Paper 1
Report on the Examination

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Overall

As the first examination for the new AS Mathematics specification, this paper presented challenges. The most significant challenge was the new assessment objectives which led to changes in the demands placed upon the students. To further support this, a new type of mark, an R mark, was introduced to be awarded for mathematical rigour, particularly in a 'show that' or 'prove' question.

Students showed confidence and competence in carrying out routine procedures, as in questions 4, 9(d), 10 and 13(a). However, when a method had to be selected from various options or original thinking was required, as in questions 5, 6, 7 and 15(b)(i), many struggled.

The quality of algebra was lower than expected, which hampered the solution of correctly formed equations. There was evidence of the intelligent use of the newer calculator functions, but also of a lack of appreciation of their limitations.

Question 1

This question proved quite challenging with around 40% of students choosing the correct second option, slightly ahead of the 35% who chose the third option.

Question 2

Here the similarity of the answers resulted in many students making the wrong choice. The correct answer was most popular, but was only chosen by 35%. The second favourite was option 1, suggesting that many calculated the gradient of the radius from the origin to the centre rather than the tangent at the origin.

Question 3

Here most correctly identified the end points of the interval. Many included the end points in their interval and so lost the accuracy mark.

Question 4

In part (a), the basic principles were well recalled, and the majority correctly handled the minus sign. Extra terms were not penalised.

In part (b), a proportion ignored the instruction "Using your expansion", and so scored no marks. A common error was to use 0.994, or 0.006 for x. As in part (a), those who had used more terms to obtain 0.976215 were not penalised on this occasion.

Question 5

Here it was insufficient to state the midpoint or the gradient of the perpendicular bisector. These facts needed to be applied in a method leading towards finding the values of c and d.

Many correctly obtained the required gradient equation. Fewer substituted the coordinates of the midpoint into the equation of the bisector. Many instead stated that *C* and *D* lay on the bisector leading to wrong equations. Even where the two correct equations were obtained, poor algebra often led to wrong answers. A common error was to say that since $\frac{d-2}{6-c} = \frac{1}{4}$ then $d = 3$ and $c = 2$.

Question 6

It was pleasing to see a variety of approaches in part (a), the most popular being to show length of *AC* = twice length of *AD* and then to use trigonometry. Many students, however, simply stated *AC* = twice *AD* with no justification. Others started from the given result and, after a circular argument, arrived back at the same result. Clearly this does not constitute proof. Students should realise that when two facts are stated (area and length) and a result is expected, both facts are likely to be needed.

The quality of explanation was poor, with great confusion between the use of upper and lower case letters. Errors such as $AB \times BC = AB^2C$, were not uncommon, indicating a lack of experience of working with geometry.

In part (b), most used $\tan A = \frac{\sin A}{\cos A}$, but cancelling of the $\sin A$ meant that only one solution could then be found.

Use of the graph function of the calculator was an acceptable method here, but a sketch and an explanation of what it showed were expected.

For part (c), the majority of students had calculated A = 60° at some point in this question.

Question 7

This question was intended to discover whether the student had progressed beyond the type of investigation which might have been carried out at GCSE. There were a minority of answers where the student identified the central features, showed what happened with endings of 1, 3, 7 and 9, and then completed the proof efficiently. Some of these were very elegant and brief, but this was not necessary to earn the R1 mark for mathematical rigour.

Many looked at 7^4, 11^4 and 13^4, and often many more examples, failing to realise that this approach in itself would never prove anything.

Question 8

In part (a), most correctly read the graph and then correctly used the coordinates to give the required P and V values.

The majority seemed well practised in the first step for part (b), writing the equation as $\log_{10}P = \log_{10}c + d\log_{10}V$. Many progressed to a correct solution easily and completed the question. Others became confused about what was a log and what was not or failed to handle the negative values and negative gradient. Those who tried to use point *A* and another point to generate simultaneous equations usually became lost at some point in the algebra.

In part (c), most remembered to include the units, relating the mathematical model back to the physical situation behind it.

Question 9

Throughout this question there seemed to be two categories of student: those who were familiar with this sort of practical exercise, and had carried it out, and those who had perhaps only read about it. The former found this an easy source of 7 or 8 marks; the latter demonstrated through their answers that they did not really understand what was expected.

In part (a), the variety of detail in the acceptable answers showed the understanding of these students.

Those who had completed part (a) could generally supply the missing numbers in part (b), but not all realised the importance of 5 significant figures for $\mathrm{f}(x + h)$ in this process.

Part (c) was surprisingly poorly answered, with many giving the more general answer, $1 - 2x$, rather than the specific –5. There were also many cases of 5 or 0.

Many students used the formula given in the formula booklet to make a successful start in part (d). The better ones adapted this to $\mathrm{f}(3 + h)$ and went rapidly to the answer of –5. Others persisted with $\mathrm{f}(x + h)$ but did not always continue to obtain –5. It was common for $\frac{h - 2xh - h^2}{h}$ to be reached but when the h was cancelled the single h on the top just vanished. This led to a final answer of $-2x$ and then –6. It was common then to see a correct answer to (c) altered to match this incorrect value.

Question 10

This lengthy question tested a range of skills and gave students the opportunity to show how well they had mastered these. There were few who could not pick up some marks here.

For part (a), most started off with a correct combination of the $x\sqrt{x}$ into a single power and differentiated the expression correctly. It was expected that at this stage they would explain that for a stationary value the gradient was 0. Many simply used this fact.

Here one approach was to solve the equation and select $x = 1$. This approach did the groundwork for part (b). Alternatively, they could verify that $x = 1$ resulted in a gradient of 0. This approach was easier here but meant that more work was needed in part (b).

Use of the second differential was needed to prove that this was indeed a maximum. Finally, it was necessary to show that $x = 1$ gave $y = 3$. Many omitted this last step and so also lost the R1 mark, which required clear mathematical rigour throughout. However, simply failing to explain that for a stationary value the gradient was 0 did not result in the loss of the R mark.

For part (b), as an alternative to algebraic methods, it was permitted for students to use graphical calculators to identify this second stationary point.

Question 11

Students did well here, with over 80% of students identifying the correct option. There was no clear second choice.

Question 12

Students displayed excellent knowledge here with over 80% choosing the correct third option. The fourth option was chosen by most who did not choose the third.

Question 13

In part (a), the graph was generally well drawn with many students scoring full marks. Inaccuracy with the second section was the main cause of difficulty.

In part (b), most students seemed familiar with the concept "distance = area under the graph". However, what "under the graph" meant was not well applied. Having obtained ½ × 3 × 4 = 6 for the first area, many calculated ½ × 5 × 6 = 15 for the second area. Others stated that the vehicle was "back at *P*" after 6.5 seconds, clearly confusing velocity and displacement. Many obtained the correct areas, but added them all together, giving the total distance travelled rather than the distance from *P*. A significant minority handled the plus and minus areas well for a straightforward 3 marks.

Question 14

For many students part (a) was a straightforward application of a practised routine:

- $F = ma$ applied separately to each particle
- T eliminated from the two equations
- Use of $s = ut + ½at^2$ to complete the solution.
-

A minority started with a single equation, $1.8g - 1.2g = ma$, which received zero marks. An equation separated from its underlying mechanical principle is hard to grasp, as evidenced by more of these students using $m = 1.8$ rather than $m = 3$.

Some students chose the wrong *suvat* equation and had to apply a second to find t. Premature or even final rounding sometimes lost the accuracy mark, where 3 significant figures were expected.

Students frequently approached the demand in part (b) in the wrong way. They should understand that what is required is an assumption that is necessary, sensible, specific and not already stated in the question. Thus saying that there was "no friction at the peg" or that "the string had negligible mass" scored zero marks. Similarly "no other forces act" is too general. A minority realised the necessity of sufficient length of string.

It is often better if the answer starts with an "I have assumed that" to ensure that the assumption goes on to be properly explained. For example "I have assumed that there is no air resistance" is better than just "air resistance" where the assumption is not clear.

Question 15

In part (a), most students recognised the effect of the air resistance, although some thought that Jason was behind because he was not applying enough driving force. Since "Less air resistance for Jason" and "More air resistance for Laura" were both correct answers, an unattributed "Less air resistance" did not explain sufficiently.

For part (b), most students correctly calculated the deceleration for Laura, but some had this as a positive acceleration. Some had an unexplained F in their equation, $F - 40 = 64a$, and made little progress. Others replaced this F with 64 or $64g$, getting a positive a.

It was possible to complete the question in a variety of ways:

- use $v^2 = u^2 + 2as$ and show $s < 40$ when $v = 0$, $a = -0.625$ and $u = 6.944$
- use $v^2 = u^2 + 2as$ with $a = -0.625$ and show that $v = 0$ at $s = 40$ as long as $u < 7.07$
- use $v^2 = u^2 + 2as$ with $v = 0$, $s = 40$ and $u = 6.944$ and deduce that $a < -0.603$
- as above but go back one stage to show resistive force must be >38.5 N
- use $v^2 = u^2 + 2as$ with $a = -0.625$, $s = 40$ and $u = 6.944$ to get $v^2 = -1.8$ and deduce that Laura had come to rest before this.

The first method was the most popular, but clear solutions using all other methods were seen. All of these methods lost accuracy marks when 25 was used as the value of u.

For part (c), as in question 14, the assumptions needed to be necessary, sensible, specific and not already stated in the question. Since the total resistive force was given, this was one case where “air resistance” was not acceptable. A minority recognised that reaction time had been ignored, or that the resistive force might diminish as Laura slowed. Many stated that they had assumed there was no friction (between bike and road), when in fact friction here is essential for the brakes to work.

Question 16

The majority recalled that integration was required in part (a), although some differentiated and a few used $s = vt$. A large proportion either forgot the constant of integration or did not calculate its value, losing half the marks.

In part (b), the time of 2 seconds ensured that the toy was stationary when it launched the ball. Many, however, tried to bring extraneous distances and velocities into this question. Making the model fit the situation is an important skill to be assessed. For those who did this, the actual calculation was usually carried out correctly.

Mark Ranges and Award of Grades

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