A-Level
Mathematics
7357/1

Report on the examination

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General

Performance on this paper suggests that students found it to be very accessible, with the mean score broadly in line with the 2024 paper. Few gaps were seen throughout, and questions were generally well attempted. Students generally seemed to be able to complete the paper in the time allowed.
Students performed very well on the multiple-choice questions. While all options were selected at least once, a small number of students did still leave one or more questions unanswered.
Many students made a confident start, tackling the routine questions with a high level of success.
It was pleasing to see a clear improvement in students' ability to write arguments that were more complete and well-structured. Often, especially in 'show that' questions, students concluded by rewriting the statement they were trying to demonstrate—which is a good tactic.

Question 1

This question was the most successful of the multiple-choice questions with over 95% of students choosing the correct answer.

Question 2

Just over 75% of students chose the right answer for this question. The most commonly chosen incorrect answers were options 4 and then option 2.

Question 3

Just over 90% of students chose the correct option for this question. Option 3 was the most frequently chosen incorrect answer.

Question 4

Both parts (a) and (b) had a success rate of approximately 75%.

In part (a) the most frequently chosen incorrect answer was $|x| > -\frac{1}{8}$

In part (b) the most frequently chosen incorrect answer was $\frac{1}{2}$

Question 5

Over 95% of students made some progress on this question, with just under three quarters achieving full marks. The most commonly seen errors included mistakes in integrating the $x^{-\frac{1}{2}}$ term or forgetting to include an arbitrary constant.

Question 6

A very high proportion of students were clearly well-practised and took the expected approach of simply substituting the given information into the formula, $S_n = \frac{n}{2}\{2a + (n-1)d\}$, which can be found in the formula book. Students who lost marks using this approach often took shortcuts when substituting the values or omitted one or more brackets, which led to mistakes when calculating the answer. It is good exam technique to state the formula you are about to use and then explicitly substitute the values in the correct positions.

Some students took the acceptable, but less efficient route of first calculating u_{250} and then using $S_n = \frac{n}{2}(a + l)$. This approach often led to errors.

It was acceptable to state the correct answer as a fraction or as a decimal, but as this was a terminating decimal, it should not have been rounded.
A small number of students incorrectly stated that the sum could not be negative.

Question 7

Almost 80% of students scored one mark for this question with only approximately 40% scoring both marks. Most students knew the shape of an exponential graph which is essentially what the first mark was awarded for. The most common mistakes were missing labels where the graph crossed the y-axis, incorrect asymptotes (including some cases of vertical asymptotes), and misunderstanding the significance of $0 < a < 1$.

Question 8

Just over 60% of students scored full marks on this question, and some very clear and concise solutions were seen. Almost 95% scored at least one mark, with nearly all students replacing $\sin 5x$ or $\tan x$ with their respective small angle approximations. It was encouraging to see students making fewer mistakes with the approximation for $\cos 2x$ this year. Those who made errors often forgot to insert brackets around $2x$ in $1 - \frac{(2x)^2}{2}$.

There were various valid methods to simplify the fraction seen, but students who had the most success were able to simply factorise the quadratic and cancel the common factor.
It was pleasing to see, in this 'show that' question, many students remembered to write a concluding statement such as $\therefore\ y = 3x + 1$. While, in many cases, this was not strictly necessary, since the argument began with y and was logically linked to the correct linear expression, a clear conclusion in a show that question is always to be encouraged.

Question 9

In part (a), approximately 80% of students scored full marks. Most approached the question as expected, substituting the correct values into the formula for S_n, which can be found in the formula book. Only a few were caught out by being given the second term rather than the first. Of those who made errors, often S_2 was equated to 60 rather than using $u_2 = 60$

In part (b)(i), approximately three quarters of students made some progress with approximately 45% achieving two marks. Although only a simple argument was required, it was essential to explicitly show the two starting points $ar = 60$ and $T_\infty = \frac{a}{1-r}$ then demonstrate how they are combined. The most common errors were working in terms of S rather than T or not making the starting point explicit.

Part (b)(ii) had been designed to be a very accessible two-mark question, which would help with the next part, but it proved to be surprisingly challenging. Many students seemed to attempt to answer one of a variety of different questions.
Less than 30% were able to correctly determine the maximum value of $r - r^2$. It should be noted that all calculators, of at least the minimum recommended specification, will give the correct value of $\frac{1}{4}$ directly.
Many students were unable to see the link between (b)(ii) and (b)(iii). Approximately 40% made some progress, either by starting from scratch or using the value they had found in the previous part. While some students obtained the correct critical value of 240, only around 15 % were able to deduce the correct range of possible values of T_∞

Question 10

Part (a) required very routine manipulation involving taking logs and applying log rules. Just over half of students achieved full marks on this question. Common errors included:

- Taking logs of all terms $\theta = 21 - Ae^{-kt} \not\Rightarrow \ln\theta = \ln 21 - \ln Ae^{-kt}$
- Taking logs of a clearly negative quantity eg $\ln(\theta - 21) = \ln(-Ae^{-kt})$
- Jumping too many steps in this 'show that' question; $\ln A - kt$ is given in the question, so jumping from $\ln Ae^{-kt}$ to $\ln A - kt$ without showing $\ln A + \ln e^{-kt}$ was not worthy of full marks.

Approximately 80% of students found the correct value of A in part (b)(i) and just under 70% obtained the correct value of k in (b)(ii). Although many answered these questions successfully, it is evident that the significance of the linear graph, in finding parameters in an exponential relationship, is not well understood. Many students substituted values into $\theta = 21 - Ae^{-kt}$ rather than using the relationships with the gradient and 'y-intercept.' Some students made a sign error when obtaining the value of k.

Approximately three-quarters of students scored full marks in part (b)(iii). This answer did not depend on the correct value of k so both marks were available even with an incorrect value for k.

Approximately 80% of students were able to make some progress in part (c), writing a correct equation using the values they had found for A and k. It should be noted that the use of a calculator to find a numerical solution to an equation formed from a model is acceptable, as demonstrated by the typical solution in the mark scheme.

Question 11

It was very encouraging to see students being successful in part (a). Almost 90% of students made some progress, with just under 70% scoring full marks. This was another example of improved levels of clarity in students' solutions:

- Compared to previous years, there were fewer cases of students losing marks due to spurious instances of $\frac{\mathrm{d}y}{\mathrm{d}x} =$, appearing at the beginning of a line of working.
- A higher proportion of students realised an explicit expression for $\frac{\mathrm{d}y}{\mathrm{d}x}$ was not necessary. These students often produced very concise solutions by substituting $\frac{\mathrm{d}y}{\mathrm{d}x} = 0$ after differentiating.

Students who did rearrange to obtain an expression for $\frac{\mathrm{d}y}{\mathrm{d}x}$ sometimes made errors in their rearranging.

Approximately 70% of students made some progress with part (b) and it is worth noting that full marks could be scored even if part (a) was not attempted. Most students made a strong start, substituting $y = \frac{4}{x}$ into $x^2y + 4y^3 = 8x$ to obtain an equation in x. Mistakes were made manipulating the equation to form a quartic, or failing to write the answer in the required form.

Question 12

In part (a), almost 80% of students identified the correct minimum value of f, but only 50% scored both marks, with correct set notation often not seen.

Part (b) proved to be challenging with less than half of students making any progress, and just under 20% scoring full marks. Common mistakes included:

- Stating that f is one to many
- Attempting to rearrange, failing to appreciate that finding an inverse does not prove one does not exist

Just over three-quarters of students scored at least one mark in part (c). Many students knew what the graph should look like, but common reasons for not achieving full marks included their sketch

- Not passing through (1,1)
- Not being symmetrical with $y = \mathrm{g}(x)$
- Passing through the origin into one of the wrong quadrants

Part (d)(i) was very accessible with a success rate of just over 85%. A commonly seen error was to incorrectly simplify $\sqrt{x^2+5}$ to $x + \sqrt{5}$

Just under half of students were successful in part (d)(ii). Set notation was not required here, so a variety of answers were acceptable, as demonstrated in the marking instruction.

Question 13

Part (a) proved to be very accessible, with approximately three-quarters of students scoring full marks.

In part (b) over 80% of students made some progress with just over half of students scoring full marks. Common mistakes included incorrect calculation of the gradient, which sometimes arose from poor substitution into the result found in part (a). It should also be noted that the equation of the tangent was not required to be written in any particular form. Students who found values for x, y and the gradient and simply substituted into $y - y_1 = m(x - x_1)$ were the most successful.

Part (c) was the most challenging part of this question. While approximately 60% of students were able to correctly eliminate the parameter to obtain a correct Cartesian equation, less than half were able to obtain the equation in the required form. Most students overlooked the instruction to fully justify their answer, with less than 5% correctly explaining whether to use the positive or negative square root.

Question 14

Over 85% of students were able to make some progress with this question, with just over 50% scoring over half marks and approximately 30% achieving full marks. It was encouraging to see that most students were able to identify that integration by parts was the required technique and that the integral had to be evaluated over two regions in order to find the total area.

While some students used ‘shortcuts’ to apply integration by parts, this was less prevalent than in previous years. It should be noted that some ‘shortcut’ methods do not always demonstrate enough working to score any credit if a mistake is made.

Common errors in this question included:

- Using the wrong limits for the two regions
- Applying integration by parts in the wrong order
- Mixing up signs when adding/subtracting the two integrals to find the total area

Some students applied double angle identities before integrating, but this made the task more difficult and was only occasionally successful.

It was pleasing to see some good examples of students explaining why the integral had to be split into two regions. A variety of approaches was seen when dealing with the region below the x-axis: reversing the limits, integrating $-y$ or simply changing the sign on the evaluated integral. All valid approaches were acceptable.

Question 15

Part (a) proved to be very challenging, with only about 35% of students making meaningful progress. However, it was encouraging to see many students effectively using the given information to tackle the remainder of the question. Both approaches outlined in the mark scheme were observed, but the most successful method involved comparing the gradient of the curve at point P with that of the line PQ. Students who were unsuccessful often attempted to substitute particular values to obtain a gradient or to verify the given result.

The mean score on part (b) was over half marks. The main errors in this part were caused through the poor use of notation or missing steps when showing how to add two algebraic fractions.

Part (c) was a straight forward application of the given Newton-Raphson formula and just over 75% of students scored full marks. If both marks were not achieved this was sometimes down to rounding intermediate answers rather than making efficient use of calculator functions.

In part (d) just under half of students used their approximation for x from part (c) or found a better approximation, solving the cubic equation $2x^3 - 4x - 3 = 0$, to find the distance PQ. For students who realised what they had to do, this was usually done well.

Question 16

The key word in this question was 'explain.' Just over 50% of students explained that the sum of the angles in a triangle is π radians and then demonstrated that BAC was $\frac{2\pi}{3} - x$

It was common to see students just demonstrate a calculation with no explanation, or to make incorrect statements such as "the angles in a triangle are π radians." Of course, none of the angles in a triangle are π radians.

Just over 70% of students made some progress on part (b)(i), with approximately 30% scoring full marks. Of the students who made a start, most realised they needed to use the compound angle formula for sine. Where mistakes were made, these were often down to sign errors when substituting exact values for $\sin\frac{2\pi}{3}$ and $\cos\frac{2\pi}{3}$.

Part (b)(ii) proved to be very challenging, with approximately 35% of students correctly making the link with the work done in part (b)(i)

Question 17

The mean score on part (a) was 3 out of 5, with over 85% of students making some progress. Most students were able to make a complete substitution, writing the integrand entirely in terms of u. It was encouraging to see many students understood how to deal with the constant of integration to obtain the given result.

Mistakes that were commonly seen included:

- Some students were unable to correctly simplify the substitution or made errors rearranging the substitution.
- A factor of e^x was taken outside of the integral.
- Some attempted integration by parts, sometimes after making the given substitution. This was sometimes done correctly, and could lead to full marks, but it usually led to unsuccessful attempts.

In part (b), while approximately 65% of students knew how to separate the variables and made some progress, only around one-fifth of students achieved full marks.

Many understood the result from part (a) needed to be used, but a significant number did not spot the link. Some students who integrated correctly and went on to find the constant of integration did not write their final answer in the required form.

Mark Ranges and Award of Grades

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