LEVEL 2 CERTIFICATE
FURTHER MATHEMATICS

8365/2: Paper 2 (Calculator)
Report on the Examination

8365
June 2023

Version: 1.0

Summary

Overall performance compared to last year

Compared to June 2022 this paper was a little more demanding. Some students found the questions involving differentiation to be quite difficult. Two of the topics that were introduced to the 8365 specification, using calculus to find a maximum and the product rule for counting, were questions that were not answered particularly well. Many students presented their work clearly but there seemed to be an increase in the number of responses where this was not the case. Only a few questions had a significant number of non-attempts.

Topics where students excelled

- finding *n*th term of a linear sequence
- solving a matrix equation
- identifying centre and radius of a circle
- using algebraic side lengths of a cuboid to show an algebraic equation
- expanding brackets and simplifying.

Topics where students struggled

- solving a quadratic inequality graphically
- using calculus to work out a maximum value
- increasing function
- circle geometry problem
- product rule for counting.

Individual questions

Question 1

Many fully correct solutions were seen with some making an arithmetic or sign error. A fairly common incorrect approach was to equate numerators and denominators to give two equations in d and two solutions.

Question 2

Part (a) was very well answered. The most common incorrect answers were $n + 3.5$ and $3.5n - 11.5$.

In part (b) most students managed to work out that the 36th term was the first negative term. The most frequent error was to give 36 as the answer, sometimes after –6 had been correctly evaluated. A misconception was to substitute $n = -1$ into $318 - 9n$ giving an answer of 327.

Question 3

The vast majority of students managed to correctly multiply out the matrices and accurately solve for u. An incorrect method sometimes seen was working out $t = 3 \times 1 + 5 \times 1$ and $4u + 8 = 6$.

Question 4

A wide variety of methods were used but many correct solutions were seen. Some students worked out r correctly but then used an incorrect expression for the gradient with the difference in the x-coordinates divided by the difference in the y-coordinates. The equation $\frac{r-1}{2} = 5$ was sometimes seen which gave $r = 11$ but often the rest of the method was correct. Occasionally students only had an equation using the gradient in terms of r and made no progress.

Question 5

Most differentiation was accurate but there were a significant proportion who did not realise that this was required. Those who correctly differentiated usually went on to equate to 6.75, although some took the cube root before dividing by 2 or took the square root instead of the cube root. The most common incorrect method was to solve $y = 6.75$ or to substitute $x = 6.75$ in the original equation.

Question 6

The vast majority of students gave a fully correct response. Sometimes the signs were incorrect for the coordinates of the centre and occasionally the radius was given as 36 or was not fully evaluated.

Question 7

Many correct answers were seen in part (a) with the common incorrect responses being 4 and 4.5. In part (b) some students gave the correct inequality for the negative section of the quadratic curve and some stated the roots of the quadratic. Others tried to combine the two correct inequalities into a single invalid inequality such as $-4 > x > 5$.

Question 8

Many fully correct responses were seen. Students sometimes muddled up the lengths of the sides and it was not uncommon to see *BD* or *DC* stated as 12.5 cm. However, many were able to use trigonometry correctly with their value for *DC*. Occasionally students used an incorrect formula for the area of a triangle, omitting to multiply by a half. Some students started by setting up the equation $0.5 \times BC \times AC \times \sin w = 25$ but usually made no progress.

Question 9

The working in part (a) was usually accurate and showed all the required steps. Some students did not quite reach the given answer. Occasionally students tried to use area or volume rather than adding up the lengths of the edges.

Although many students showed accurate steps to reach the given answer in part (b), many students made slips when substituting or expanding the brackets. Some students left y in their expression or substituted y for $2y$.

Part (c) was not very well answered and there were quite a lot of blank responses. Students who differentiated usually did so correctly but often went on to use higher derivatives or did not equate the first derivative to 0. Many students gave the value of x rather than the value of the maximum volume. Some students ignored the instruction to use calculus and used a trial method to test different values and work out which gave the maximum volume.

Question 10

Most students correctly rearranged the equation of line K but not all extracted the gradient from the equation. The gradient of line L was usually correctly evaluated. Not all students showed that the two gradients were perpendicular. The most common method was stating that they were negative reciprocals. Some students included x in their gradient which is a common error seen in both this and previous series.

Question 11

A great deal of correct algebraic expansion work was seen. Occasionally students made errors and some students misinterpreted the second part of the expression and squared all the terms.
A common incorrect approach was to expand both parts and then multiply the results rather than add them. Students sometimes miscopied their own work.

Question 12

There were lots of fully correct solutions seen. However, some students worked out *AC* and then used triangle *VAC* as a right-angled triangle. It was also common to see students work out *AC* but think they had found *AX* and continue with the incorrect value. There were some responses that assumed *AX* to be 7.5 cm and made no progress. A few misconceptions were seen with students working out angle *VAB* or angle *AVX*.

Question 13

The most common response in part (a) was the correct answer. Option 3 was chosen often with only small numbers choosing each of the first two.

Part (b) was well answered although a significant number started off correctly but made errors when cancelling. The most frequent error was to simplify the denominator to $4w^6$ and give the final answer $3w^2$. Another common error was to simplify the denominator to $16w^5$ and give the final answer $0.75w^3$.

Many students were able to access the novel problem-solving in part (c) although there was a similar proportion who failed to score. It was common to see the correct powers of $\frac{1}{2}$ and $\frac{1}{3}$ multiplied to give an answer of $c = 6$ and $d = 1$.

Question 14

Those who started by factorising and cancelling were usually more successful than those who expanded the numerator and the denominator, although this latter approach was seen more frequently. Those who expanded often simply cancelled by 3 or $3a$ or a and thought they had finished, not realising there were common factors to eliminate. A frequently seen incomplete answer was $\frac{20a(2-a)}{(a+8)(a-2)}$ and some cancelled the factor of $(2 - a)$ with $(a - 2)$, losing the -1. The question was a good discriminator.

Question 15

Most students were able to substitute into the equation and work out the values of a and b. Some then interpreted the resulting equation as $y = \left(\frac{1}{2}\times 3\right)^x$ and worked out incorrect values for the range. Although many students did work out the values of $\frac{1}{6}$ and $\frac{9}{2}$, it was quite common to see x used in place of $g(x)$ in the final answer. Some students confused the idea of range with a statistical range and subtracted the values. There were quite a few non-attempts.

Question 16

Many students accurately factorised the cubic equation, often using algebraic division. It was very common to see correct use of the quadratic formula to solve their equation, but a large number of students chose rounded decimals as their answer rather than the exact values required. Occasionally students who had worked correctly omitted the solution from the factor given in the question. The question was a good discriminator.

Question 17

It was rare to see a fully correct solution for this question. Most students did expand the brackets correctly even if they did not know how to proceed after that. However, a good number differentiated correctly and many of those did state that the result had to be > 0. Some thought that it was the second derivative that would be positive. Many who formed the correct inequality then either rearranged and gave an answer for a in terms of x or substituted $x = 1$ and gave the final answer $a < -\frac{5}{7}$.

Question 18

Part (a) differentiated well amongst students. The majority of students followed the instruction to select two answers but some only chose one. All of the distractors seemed equally popular.
A small majority chose the correct option in part (b). Options 3 and 4 were both chosen quite often.

Question 19

Many students were able to correctly eliminate one of the variables, often y. However, the algebra involved sometimes proved too much and mistakes were made in rearranging and simplifying. Mistakes in simplifying the expression for y were frequently seen with students multiplying the numerator and denominator by $2k$ or incorrectly cancelling. Occasionally students found an equation for k rather than for x or y.

Question 20

Many students were able to use one or both of the necessary trigonometric identities. Occasionally $\cos x$ was changed to $1 - \sin x$ or $1 - \sin^2 x$. Quite a few students omitted brackets and not all recovered them. Some students divided through by $\cos x$ or $\sin x$ at the start. A few students substituted values for the angle and made no progress.

Question 21

This question was not well answered. Many students were able to correctly work out an expression for angle *AOB* using the angles of an isosceles triangle. Quite often obtuse angle *AOD* was stated as $180 - 7x$ or $14x$ or $7x$. Those who correctly worked out that reflex angle *AOD* = $14x$ and reflex angle *BOD* = $12x$ were usually able to form a correct equation, although occasionally some omitted the brackets.

Question 22

There were some fully correct solutions seen following many different approaches. Some students tried to list some or all of the possible integers. Relevant values such as 72, 12 or 54 were often seen but frequently 36 or 48 were given as incorrect answers.

Mark Ranges and Award of Grades

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