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Examiners' Report
Principal Examiner Feedback

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Pearson Edexcel International GCE
In Mathematics Pure 2 (WMA13) Paper 01

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General

This was the first WMA13 paper under the new IAL specification. The paper had a variety of very accessible and familiar questions such as 1ab, 2ac, 4b, 5, 6 and 8, as well as ones that tested both the new content and the more demanding areas of the specification. Question 3 tested log graphs which is new to the IAL content and questions 3, 4, 7, and 9 proved to be very discriminating. The paper was of an appropriate length with little evidence of students rushing to complete the paper.

Points to note for future exams are

- Candidates should write down a formula before attempting to use it. This was particularly relevant in question 4.
- Candidates should take note of the extra demand in the new specification when finding f^{-1} in Qu 2b as well as the need to mention the continuity of the graph in Qu 7a.
- Many candidates did not understand the demand in Qu 4(i)(a) and did **fully** factorise their expression.
- Candidates need to be careful to show all the steps in "show that" questions. This was seen in Qu 4(ii) and Qu 5(a).

Report on Individual Questions

Question 1

(a) Nearly all candidates could achieve this mark. There was a general realisation that "start" implies $t = 0$ and the calculations were then performed with few errors.

(b) Again, this part was well answered with the majority gaining full marks and nearly all presenting complete working. There were occasional slips in combining the coefficients of the exponential terms. Moreover, most candidates were able to use the natural logarithm correctly. Few candidates made errors in rounding. So, this proved to be a very accessible start to the paper.

(c) This part was not answered well, with candidates continuing to have difficulty communicating reasons using mathematics. There was good work in calculating the asymptotic behaviour of the function for large values of t, and many referred a "limit" or "asymptote" at 450 but failed to gain the mark as they had not conveyed the idea of an "upper limit". Some candidates attempted to prove that 450 was the limit, with varying degrees of success. However, such a proof was not required for this mark. Others substituted N=500 and attempted to find a value of t. Most were able to then observe that this leads to the logarithm of a negative number. However, these candidates often omitted a conclusion, or their conclusion did not refer back to the value 500. A few candidates did not attempt to explain in terms of the model but made irrelevant observations such as "many toads start dying".

Question 2

(a) The majority of candidates knew how to find the composite function and went on to score both marks. Occasionally slips were seen with one of the functions or else not understanding how to simplify $\dfrac{12}{\frac{5}{2}\ln e^2 + 1}$ to 2

(b) Part of the demand of the new specification is knowing that a function is defined by both an equation **and** a domain. Most candidates knew how to find $f^{-1}(x)$ and went on to score one or two marks. Many lost the second mark for sloppy notation and the third for the lack of a correct domain.

To score all three marks examiners were looking for $f^{-1}(x) = \dfrac{12}{x} - 1 \qquad 0 < x < 12$

(c) The last part of the question was very accessible with many going on to solve the correct quadratic equation $x^2 + x - 12 = 0$. Although this had two solutions $x = 3, -4$, only $x = 3$ was a solution to $f^{-1}(x) = f(x)$.

Question 3

This question was interesting in that it saw the entire range of marks awarded. It is a new topic to the IAL specification, and it was noticeable that many were not prepared for a question of this type.

Over 25% of the candidates scored either no marks or 1 mark in this question

(a) Most candidates were able to obtain the correct gradient and sign, but by far the most frequent error was for candidates to write their '*c*' as log 4. Some candidates ignored the logarithmic axes altogether and simply gave a linear equation in *y* and *x*.

(b) The majority of candidates attempted this part via their equation in (a). The most common error was where candidates arrived at $y = 4x^{-\frac{2}{3}}$ following the incorrect equation

$$\log y = -\frac{2}{3}\log x + \log 4$$

Many different and successful approached were seen, with some candidates scoring no marks in (a) but using the two given coordinates to find values for *p* and *q* before writing $y = 10000x^{-\frac{2}{3}}$.

Question 4

(i) (a) The majority of candidates used the quotient rule and were able to access this part successfully. The most common errors were the differentiation of $(2x + 5)^2$ as $2(2x + 5)$ or omitting the minus sign in the numerator. There was greater difficulty with the simplifying process. Those who took out a factor of $(2x+5)$ immediately were most successful. Of those who multiplied everything out, many did not go on to factorise, so scored no further marks. Some made numerical errors in this longer process and were unable to get the final A1. Those who had differentiated incorrectly often found the x^2 terms cancelled, leaving them without a quadratic numerator and so scored no further marks in part (i)

(i)(b) Those who still had a quadratic numerator at the end of (a) generally did score the M1 for finding the two critical values from their factorised quadratic, or by a successful application of the quadratic formula where they had not factorised. Very few went on, however, to give a fully correct statement of the interval with most having at least one incorrect inequality.

(ii) This was reasonably well attempted, and many candidates gained the majority of marks available. The chain rule was successfully applied in most cases. Those candidates who obtained the first two M marks generally went on to score full marks, with the $(\sin 4x)^{-1/2}$ term being handled by taking it out as a common factor, or more frequently, by multiplying by it when $g'(x)$ had been set to zero. In show that questions it is important to remind students to show sufficient working and steps when proceeding to the given answer.

Question 5

This question was often answered well, with many able to score all 8 marks. However, some questionable algebra was seen, and it would have been pleasing to see more candidates actually writing *equations*, rather than disjointed lines of working.

(a) Most were able to quote at least one of the trigonometric identities for $\tan 2x$, $\cot x$ or $\sec^2 x$, but these had to be substituted into the given equation to obtain the B mark. An error occasionally seen at this point was the use of expressions involving $\sin x$ and $\cos x$, rather than t [or $\tan x$], as indicated in the question. An example would be $\cot x = \cos x/\sin x$; students pursuing this route tended to make little or no progress. "Questionable algebra" was frequently seen when candidates tried rearranging their equation in t into the stated quartic equation, $5t^4 - 24t^2 - 5 = 0$. Inability to obtain a correct common denominator or various bracketing errors were frequently encountered.

(b) Solving the quartic equation proved surprisingly challenging for a fair proportion of candidates. A small number managed to transpose or mis-read the equation, with $+24t^2$ the usual modification. Without being able to solve in an appropriate fashion, all four marks in this part were forfeited.
A frequently seen (and, of course) incorrect attempt was along the lines of:

$$5t^4 - 24t^2 = 5$$
$$\Rightarrow t^2 (5t^2 - 24) = 5$$
$$\Rightarrow t^2 = 5 \text{ or } t = \pm\sqrt{5} \text{ or } t = \sqrt{24/5} \text{ etc.}$$

Candidates following this kind of route scored 0 marks even though correct answers were seen. However, many directly factorised the quartic, and correctly realised that $t^2 = \sqrt{(-1/5)}$ should be rejected. Reducing the quartic to a quadratic was an acceptable alternative method, but some confusion resulted for those candidates who replaced t^2 with t. Obtaining $t^2 = 5$ often led to $t = \sqrt{5}$ only, and hence two solutions were missed. A small number of candidates ignored the – sign in $\sqrt{(-1/5)}$, and as a result found extra incorrect solutions. Loss of the final accuracy mark was common.

Question 6

(a) Most candidates just wrote down the correct coordinates with no working, although a few scripts did show evidence of how they were derived. For those who did not score both marks, a common error was stating the x coordinate as 5.

(b) Candidates were generally successful in this part too. Most attempted to solve the two correct equations with very few attempting an approach via squaring. In cases where full marks were not scored, it was more often than not down to either a sign error and/or a slip.

(c) This part of the question was found to be the most challenging. There were several blank or incomplete responses. Candidates who made most progress did so following a diagram which helped them understand the problem. Two mark were available to candidates who used $y = kx + 2$ with $(2.5,3)$ to find $k = 0.4$. Only the most able students were able to understand that k also needed to be less than 4 before reaching the answer $0.4 < k < 4$

Question 7

(a) Nearly all candidates knew what was required for this part of the question and calculated the value of y at 0.8 and 0.9 correctly. Very few were awarded both marks however, as their reasons were incomplete. It is requirement of the new specification to state that the function is continuous as well noting the change in sign before concluding that a root lies in the interval.

(b) Nearly always correct but common errors were centred on not fully reading the question. The question differed from previous years' style on this topic by asking for x_2 and x_5 with some just giving the usual x_2 and x_3.

(c) This proved to be a challenge for many with few fully correct solutions seen. The method of differentiation for finding turning points was well understood and most could correctly differentiate the given function and achieve a correct value for the first minimum point. However a surprisingly number of candidates having correctly differentiated, then proceeded to lose the minus sign in solving the equation when equating to zero and rearranging. A surprising number of candidates were unable to appropriately deal with the $3x$ and a few went on to find the second differential and try to use that. Very few were able to secure the final two marks, with many seeking out the next local maximum rather than the next local minimum. A diagram was given in the question and candidates should be encouraged to use this to help them understand what is required.

Question 8

(i) Most candidates scored the first M mark for knowing that the integral was of the form $\ln(3x-1)$. However errors in the coefficient were common with answers such as $2\ln(3x-1)$ or $\frac{3}{2}\ln(3x-1)$ frequently seen. The mark for using the limits and applying a log law was scored by many. The most common mistake, however, was not attempting to process $\frac{2}{3}\ln\left(\frac{125}{8}\right)$ into a simpler form.

Some candidates used a substitution, which was acceptable, but a common mistake was to not change the limits. Also often seen was the use of a calculator to get a decimal answer instead of an exact answer.

(ii) Many candidates got full marks in the first part of this question, the most successful method being long division. Candidates who tried equating coefficients were less successful – typically scoring two of the three marks. This was generally due to poor arithmetical processing and sign errors.

A lot of candidates went on to get either two or three marks in the final part too. Sadly some candidates integrated the fraction $\frac{4}{(x-1)^2}$ to a logarithm function and some differentiated it (whilst correctly integrating the other two!)

Question 9

(a) was well attempted and mostly fully correct. Occasionally R was given only as a decimal, and there were a few rounding errors in α and a few candidates who worked in degrees, but most candidates scored all three marks.

(b) There were a significant number of generic statements of what constituted a stretch and/or a translation, with no link to the question. Many of those candidates who applied their work in part a) adequately described the stretch, stating both size and direction, often stating a 'multiplication of y values' or similar. However there were a significant number who thought the stretch factor was $1/\sqrt{41}$. Descriptions of the translation were sometimes inadequate, usually stating 0.675 as the 'size' but not always specifying the direction. Use of a translation vector was rare; the more frequent statements were "move 0.675 to the left" or "subtract 0.675 from the x-values".

(c) Candidates often found one end of the range, usually $g(\theta) \geq 2$, by using the value $\cos(\theta+\alpha) = 1$. However they frequently failed to recognise that $(f(\theta))^2$ had a minimum value of 0, which prevented them from finding the upper end of the range for $g(\theta)$.

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