Examiners' Report
Principal Examiner Feedback

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Pearson Edexcel International A Level
In Pure Mathematics (WMA13/01)
Paper: WMA13/01

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General

This paper proved to be a good test of candidates' ability on the WMA13 content, and it was pleasing to see many candidates demonstrating what they had learned despite the anticipated disruption to learning experienced. Overall, marks were available to candidates of all abilities and the parts of questions that proved to be the most challenging were 4(b), 7(c) and 8(b) and 10(a).

This paper had several "show" questions. Candidates should continue to read the questions carefully and make sure that they show sufficient stages of their working so that they can score full marks. The questions for reference were 1(a), 4(a), 6(i), 6(ii)(a), 7(b), 8(b), 9(b), 10(a). There were also other parts which stated that either relying on or entirely relying on the use of calculator technology was not allowed so attention should be paid to this information at the top of relevant questions.

Report on individual questions

Question 1

This was a very accessible question for the candidates to start with and many were able to score a pleasing proportion of the marks.

Part (a) was tackled quite well. Candidates who used a common denominator of $(x+3)(x+4)$ made better progress than those that used $(x^2+7x+12)(x+4)$; this more complicated approach often led to mistakes. A few lost marks by not showing sufficient intermediate steps; attempting to combine the two fractions using a common denominator and then simplifying and factorising the numerator needed to be seen.

In part (b), most candidates were able to change the subject by cross multiplying and collecting terms. Some, however, lost the accuracy mark for not writing the result with the correct notation. Very few gained the final mark for correctly stating the domain. Candidates should be reminded that a definition of a function must include the domain.

In part (c)(i), most candidates made a good attempt here, but some lost marks for incorrect attempts to differentiate, by not using either the product or quotient rule. A few candidates lost marks for simplification errors. In part (ii), of those who did differentiate correctly, very few obtained the final mark. For those who stated that it was an increasing function, but who did not get the mark, did not do so because the reason given was insufficient - they did not identify why the derivative would always be positive i.e., $(x+3)^2 > 0$. Otherwise, the most common incorrect answer was that it was a "decreasing function because of the higher power on the denominator". A number of candidates tried to find the second derivative. Overall, there seemed to be a lack of understanding of what an increasing function was and how to show that an expression was positive.

Question 2

This question was generally very well attempted although scoring full marks was extremely rare.
In part (a), the majority of candidates scored 2 marks. A single error usually occurred from an incorrect x coordinate. Common incorrect answers included $\frac{8}{\sqrt{3}}$, 18, 8 or just 13. Some simply confused point P with the intersection of f(x) and the y-axis.

In part (b)(i), about two thirds of candidates gave the correct range or correct follow through. Most used the standard notation $\mathrm{f}(x) \geqslant 5$ (or $\mathrm{f} \geqslant 5$). $\mathrm{f}(x) > 5$ was a common error.
In part (ii), again, the majority of candidates scored the mark in this part. The majority of these showed meticulous calculations. Occasionally the solution fell short after finding the initial $\mathrm{f}(4)$ or faltered as the result of a bracketing error.

The majority of candidates scored 3 or 4 marks in part (c). The final mark was usually lost for failing to display the final combined inequality rather than additional errors within it. Some simply moved on after stating $x > 2,\ x < \frac{24}{5}$ somewhere within their working. It was quite common to see $x < \frac{13}{3}$ or $x > \frac{13}{3}$ included within a pair of inequalities after the critical values had been calculated. Sometimes these were not refined to a single final answer. It was not uncommon to see arithmetic errors within one of the equations, resulting in an incorrect critical value. A few formed a quadratic equation or inequality. These candidates were usually successful to the end, although occasionally the quadratic remained unsolved.

In part (d), most candidates scored at least one mark. Success was often achieved with showing little or no working. Most errors occurred in calculating b, with $-\frac{1}{3}$ being the most common incorrect answer.

Question 3

This was generally attempted well by candidates, with a pleasing number able to score the majority of the marks available.

In part (a), most candidates realised $G = 0$ and proceeded to obtain a linear equation in t (or k) by taking logs. Only occasional errors of manipulation were seen, and k was often expressed as an exact value. However, stating the year and month when gold extraction started proved difficult for many, with surprisingly few 'March 1814' answers seen. A significant number of candidates equated 14.2 years to February 1814, perhaps not taking into account that there are 12 months in a year.

In part (b), most candidates were able to substitute $t = 70$ into the given equation, leading to a value of 37.5, but the units (tonnes) were often omitted, resulting in loss of an easy mark. It is important in questions modelling real life situations that candidates look out for units and use them appropriately. A few substituted '1870' rather than 70, leading to a value close to 40 and no marks for this part.

In part (c), many gave a correct value of 40 for the limit, although answers such as 10 and $\frac{40}{\mathrm{e}}$ were not uncommon.

Question 4

This question proved to be particularly challenging with nearly a significant number of candidates scoring no marks.

In part (a) many candidates were able to use the correct formula in the given equation. Most were also able to process the sin 30 and cos 30 and use the exact values. However, very few were unable to show the division of $\sin\theta$ by $\cos\theta$ to become $\tan\theta$. The occasional slip and missing lines of working cost some the final A mark for this 'show that' question.

Part (b) proved to be more challenging with too many candidates unable to see the connection with part (a) and hence making it more difficult to solve. Some successfully re-arranged to get $\tan\theta$ in terms cos 20, sin 10 etc. and were able to find the two required angles. Those that used $\tan(\theta + 20) = 2\sqrt{3}$ usually gained full marks. A few candidates left extra answers within the given range and lost the final mark.

Question 5

Whilst some good responses were seen, far too many candidates found these integrals quite challenging.

In part (i), some candidates either insisted on multiplying out $(2x-3)^3$ or resorted to a natural log function, so no marks could be awarded. Alternatively, expressions involving a denominator of $(2x-3)^4$ were also seen, suggesting differentiation rather than integration had been carried out. The integration is probably most easily performed by substitution, in this case setting $u = 2x-3$. If they were not using a substitution, a common error was forgetting to divide by 2 (the derivative of $2x - 3$), thus obtaining $\frac{-4}{(2x-3)^2}$ after integration and resulting in an answer of $\frac{96}{25}$. Some candidates forgot to substitute limits into their expression.

In part (ii), candidates should have realised that the multiplying x is just half the derivative of (x^2+3). Again, a substitution method is straightforward, although good candidates were able to establish the result 'by inspection'. A fair number of candidates could not be awarded the final mark, despite having obtained the correct algebraic expression, as they had forgotten to include the constant of integration. Some insisted on integrating 'separate terms', leading to answers such as $\frac{x^2}{2}(x^2+3)^8$. A very small minority of candidates decided to expand $x(x^2+3)^7$ fully before integrating, sometimes successfully!

Question 6

This question was attempted well and around half of the candidates were able to score a good proportion of the marks in total.

In part (i), less than half of the candidates scored 4 marks. Occasionally the derivative of $3\ln(x^2-5)$ was not attempted or resulted in a different expression involving a natural logarithm. Frequently the numerator of the result became 3 rather than $6x$. $3x$ and $2x$ were also quite common. A significant number of candidates achieved only one mark.
The correct answer came quite readily to the majority of those who differentiated correctly. Occasionally a poor bracket expansion, for example $-8x(x^2-5) \Rightarrow \ldots - 40x$ lost the final mark.

There was a lower success rate than in part (ii) compared to part (ii) with probably a significant number failing to score any marks.

In part (a), the most common route was to use the chain rule on $\sin 2x$ and this provided many with a fluent and correct solution. Errors in attempting to use the chain rule included $2\cos x \sin 2x$. The alternative method was a safe passage for many candidates. However, it did provide more pitfalls, and some did differentiate the $4x$ as they used an identity for $\sin 2x$, and then differentiated everything again afterwards. Not all candidates using this method quoted or rearranged to a correct formula.

In part (b), only about half of those who completed part (a) successfully gave a correct answer in this part.

Even when the knowledge that $|\sin 2x| < 1$ was displayed, wrong answers such as -8, 8 and 4 were frequently seen. Another example of incorrect working seen was max $= 4 - 12x^2$ without any evaluation. A number of candidates sought to solve $\frac{d^2y}{dx^2} = 0$, usually without success.

Question 7

This question was challenging for many with a significant number unable to score anything but about around half were able to gain 5 or 6 marks.

In part (a), some of the candidates were unable to substitute 45 and solve the given log equation to find the value for *M*. The rest usually scored both marks and usually their answers had units.

In part (b), a significant number of candidates failed to show all steps when attempting the 'show that' part of the question. However, a large number were able to manage the manipulation and gained both marks for the correct values of p and q. A few left p as $10^{0.684}$

A correct interpretation in part (c) was extremely rare. Many realised that it was the mass of the tree but did not explain that r had to be 1 cm. Too many candidates opted for answers relating to "initially" or "at the start".

Question 8

This question was very challenging for many with a significant number scoring 0 or 1 mark.

In part (a), around half the candidates were able to score this mark for a correct shape and position of the graph. No values were required on this occasion.

In part (b), this 'show that' section proved challenging with many candidates unable to demonstrate all steps required. Knowing the formula for differentiating arcsin x was insufficient and required more manipulation to gain any A marks. This proved to be a significant challenge for those who were familiar with this and had not appreciated the anticipated method of finding $\frac{dx}{dy}$. Those that differentiated to get $\frac{dx}{dy} = 2\cos y$ needed to show the connection between $\cos y$ and the x's in order to proceed successfully to a fully correct solution. Candidates should be reminded to take note of the number of marks allocated to a question and to also be aware of the need to provide all stages of working, particularly on the "show" questions.

In part (c), a significant number of candidates scored well on this part, with most able to find the value of x and the gradient of the tangent hence finding the equation for the tangent. A few lost the final mark with sign slips.

Question 9

Part (a) was generally well answered, usually by applying the product rule to $(x^3 - 4x)$ and $e^{-\frac{x}{2}}$, although some lost the accuracy mark for bracketing errors. Those who failed to gain any credit here at all typically identified the factors as x and $(x^2 - 4)e^{-\frac{x}{2}}$, missing the fact that the second part was also a product. They then attempted to apply basic differentiation methods to a product and so the result was incorrect. The use of the quotient rule was not successful for most of the candidates who used it. Most candidates who attempted method (iii) using successfully scored full marks. Many candidates gained both marks for a correct unsimplified answer.

Part (b) proved to be more challenging, with common mistakes being to set their expression for $\frac{dy}{dx}$ equal to 0 or to x, without attempting to evaluate the equation for the normal first. It is important for candidates to demonstrate every step of a show that question, and some marks were lost due to missing steps and simply writing out the required final answer. Some candidates began with the required solution and attempted to work backwards, which was not an acceptable approach.

In part (c)(i), nearly all candidates made some attempt at this part of the question, and most were successful in substituting -2 into the correct equation. Some failed to gain full marks because of incorrect rounding. In part (ii), many obtained the correct answer of -2.0226, but for others there appeared to be some misunderstanding of what was being asked - some just re-wrote their answer to the first part. Some candidates did not attempt this, not realising that they simply needed to continue the iteration until it converged to a point.

Question 10

Many candidates found this question demanding, although it was pleasing to see a small proportion of fully correct responses. Since this was the final item on the paper, some had possibly run out of time and made no attempt at an answer.

In part (a), whilst nearly all could correctly multiply out the brackets, quite often $4\cos^2 2x$ was simply changed to $4\cos 4x$. A great many seemed unable to use the double-angle formula correctly or to adapt it for use with $4x$ rather than $2x$.

In part (b) most who attempted this realised that, in order to find a, y had to be equated to zero. Many were able to proceed to $\cos 2x = -0.5$ and hence possible values for x. However, they often found it difficult to relate their various values to a, and answers such as $\frac{\pi}{3}, \frac{4\pi}{3}$ and other incorrect values were often seen as well as the correct $\frac{2\pi}{3}$. The diagram should have helped candidates to find the correct value for a. To perform the integration, an expression of the form $p + q\cos 2x + r\cos 4x$ (as found in part (a)) was required. If such an expression was not used no further progress could be made. For those with an expression of the correct form integration marks could be awarded, but many could not proceed to an answer as they had no value (or an inappropriate value) for a. Occasionally values for a in degrees were used as limits for the integration. Some did the integration in two stages: 0 to $\frac{\pi}{3}$ and $\frac{\pi}{3}$ to $\frac{2\pi}{3}$. Many candidates were unable to integrate $\cos 2x$ (or $\cos 4x$) correctly, with $-\sin\left(\frac{2x}{2}\right)$ or $2\sin 2x$ often being seen.

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