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Examiners' Report
October 2025

International Advanced Level in Pure Mathematics P4

WMA13/01A

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General Comments

This paper proved to be a good test of learners' ability on the WMA13 content and plenty of opportunity was provided for them to demonstrate what they had learnt. Marks were available to learners of all abilities.

In general presentation was very good. The learners often showed all the work required using appropriate mathematical notation. However, some learners did not show sufficient working in "show that" questions such as 2(a), 4(a) and 5(a).

Question 1

Overall this was a very well answered question with a large number of learners achieving full marks.

In part (i)(a), learners performed well with occasional errors in the coefficient or index.

Part (b) was also answered well but not as well as part (a). Most learners achieved the correct logarithmic form but $\frac{8}{5}$ was often seen as the coefficient rather than $\frac{5}{8}$. A very small minority integrated the numerator and denominator separately.

In part (ii), learners who realised how to adapt the integrand by splitting up the fraction generally went on to complete this question accurately, although there were some errors when attempting to combine ln terms. A significant number chose to approach this question by using integration by parts, which was not always executed successfully.

Question 2

In part (a) most learners used the product rule to differentiate and were able to apply it correctly, gaining the first 3 marks for the correct derivative. Beyond this, the required trigonometric manipulation proved more discriminating, with many learners making a start but not proceeding to a complete proof.

A common error was attempting to work in terms of $\tan\left(\frac{1}{2}x\right)$ and $\sec\left(\frac{1}{2}x\right)$ without converting to $\sin\left(\frac{1}{2}x\right)$ and $\cos\left(\frac{1}{2}x\right)$. Of those learners who successfully used the correct identities, some did not recognise the requirement to apply the identity $\sin\left(x\right)=2\sin\left(\frac{1}{2}x\right)\cos\left(\frac{1}{2}x\right)$ or applied it incorrectly.Learners should be reminded of the importance of clearly showing all stages in a proof to avoid omitting any crucial points in their working.

Part (b) was solved correctly by a very high proportion of the learners. A rare error was the use of degrees instead of radians.

Part (c) proved much less accessible. Many continued to use iteration, and those that did attempt a suitable interval, did not choose an appropriate function. Despite the instructions in the question, few learners stated the "suitable function" making establishing that values were substituted and the function used, difficult for the examiners. A significant number of learners just evaluated the *y* values at 0.72825 and 0.72835 and in some cases even stating "change of sign" when this was not the case.

Question 3

In part (a), most learners successfully performed polynomial division, obtaining the correct quotient and remainder. Errors typically involved incorrect signs in the remainder or misplacement of terms, which affected part (b). Some learners

used staged division or the method of comparing coefficients, both of which were generally effective. Mistakes were mainly due to incorrect algebraic manipulation or transcription errors.

In part (b), the differentiation of the fractional term appeared challenging for many, with frequent misuse of the chain rule and confusion with logarithmic differentiation. Those who applied the quotient rule tended to be more successful. Most learners could form the equation of the tangent using their gradient, but common errors included using incorrect values for x or mistakenly finding the equation of the normal.

Question 4

Overall this question was reasonably well attempted with learners demonstrating the ability to apply the chain rule as well as recall and accurately apply double angle formulae.

In part (a), most learners could apply the chain rule accurately and did so immediately, following the main scheme. Occasional errors in the coefficient of $\sin 2x$ were seen. Most could then select and apply the required double angle formulae and simplify to achieve the required result. A minority of learners manipulated y by using log rules and/or identities before applying the chain rule and learners who did this often went on to score full marks in this part.

In part (b), most learners understood what was needed to find x and would do so accurately. However, many learners did not then go on to attempt to find a value of y.

Question 5

In part (a), the majority of learners gained the initial mark. Most then correctly applied trigonometric identities, but a few did not gain the final mark due to incorrect notation such as using mixed variables. Forming a single fraction was generally well done, but errors arose when the lowest common denominator was not used. Many completed the proof correctly, but some did not gain the final mark by omitting key steps, in particular not obtaining $\frac{\sin A}{\cos A}$ before tan *A* or not indicating the appropriate cancelling terms.

In part (b)(i), most learners solved the equation correctly, but common mistakes included leaving answers in arc tan form or failing to divide by 2. Some made rounding errors and some provided additional solutions.

In part (b)(ii), many learners achieved full marks, with most finding at least one correct solution. Marks were not awarded when learners did not follow the instruction to use part (a) and many learners proceeded to a quadratic equation in $\tan\theta$. These attempts could gain some credit for correct answers, but full marks were not available in these cases. Of those who proceeded correctly, some did not score the accuracy mark due to rounding errors.

Question 6

This question was a good source of marks for many learners.

Part (a) was extremely well attempted by learners with very few errors.

In part (b), the majority of learners found the upper bound of 3 however 0 was often seen as an incorrect lower bound. There were also mistakes with the inclusivity of the limits as well as the notation used.

In part (c), the vast majority of learners could accurately find the inverse function. However, a fair number either did not include a domain or did not appreciate the domain would be the same as the range of g, occasionally there would also be incorrect notation here.

In part (d), a large majority of learners found the y coordinate of the vertex and many also found the y-intercept and realised that these were the limits of k. There were some issues with selecting the inclusivity of these limits but generally this part was well answered.

Question 7

In part (a), nearly all learners scored full marks, with only a few making errors in evaluating exponential expressions.

In part (b), differentiation of the exponential function was generally well done, with correct use of the quotient or product rule. The most common error was a sign error in the derivative. Attempts using the product rule were less successful, often omitting negative indices.

In part (c), most learners correctly set the numerator to zero and attempted to solve, but some could not gain full marks due to errors in part (a). Some learners set the entire fraction to zero and did not progress further. Those who reached the logarithmic stage generally performed well but some did not process their equation correctly or had obtained an unsolvable equation due to previous errors.

Question 8

Part (a) was generally well answered as the techniques required were familiar to most learners. A common error was the use of radians instead of degrees, or having the tan value inverted. Some learners also gave the value of R as a decimal rather than in exact surd form as required.

Part (b) was generally well answered. In part (i) commonly seen incorrect maximum values were $12-\sqrt{109}$, 12, 22, 15 or 25. Learners who gave incorrect values in part (i) almost invariably gained an incorrect value in part (ii). In part (ii) the most common error here was learners not setting the $30t + 16.70$ equal to 180, many went for –1, 0 or 360. Another common error was to not acknowledge the coefficient of 30.

In part (c), most learners were able to achieve the correct time. The most common error in this part was incorrect manipulation of the equation, leading to an incorrect answer.

Learners appeared to find part (d) challenging with very few correct answers seen. The most common strategy was to multiply the answer to (b)(ii), and in some cases dividing this again by 4. Many also did not include units on their answer even when it was correct.