Examiners' Report
Principal Examiner Feedback

January 2025

Pearson Edexcel International Advanced Level
In Pure Mathematics (WMA12) Paper 01

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This proved to be a suitable test of the specification with early questions giving candidates confidence as well as later ones providing stretch and differentiation. Most of this cohort seemed well prepared for the test, showing good skills in algebra, calculus and trigonometry.

Common areas that led to a loss of marks were

- Failure to show sufficient working with an over reliance on calculator technology (witnessed in Questions 4, 5c, 7, 9 and 10b)
- Failure to show sufficient steps in a proof (witnessed in Questions 3b, 7i, 9, and 10a)

The paper was of an appropriate length with no evidence of candidates unable to finish.

Question 1

This proved to be a suitable opening question to the paper with most candidates scoring all 4 marks. Reasons for a loss of marks were;

- Using the calculation $\dfrac{254-2}{3}$ to find the number of terms
- Making algebraic slips when attempting to solve $254 = 2 + 3(n-1)$

Generally, candidates used a correct formula when finding the sum of the series.

Question 2

Questions on the binomial expansion are usually well done and this was no exception. As a result, the majority of candidates scored 3 or 4 marks in part (a). Reasons for losing one or two marks in part (a) were;

- Slips in signs when multiplying out terms like $^8C_2(2)^6 \times (-5x)^2$ and $^8C_3(2)^5 \times (-5x)^3$
- Loss of brackets, so writing terms like $^8C_2(2)^6 \times (-5x)^2$ as $^8C_2(2)^6 \times -5x^2$

Part (b) was surprisingly, found more challenging. It was not uncommon to see scores in this question of 4 marks out of 5 with (b) incorrect, or not attempted. A relatively simple way to

find the value of x was to solve $2 - 5x = 2.05$ to reach $x = -0.01$. Common incorrect answers were 0.01 and -0.1.

Question 3

Question 3 proved to be the first major hurdle for many candidates.

In part (a), the form of the answer was given as a help to candidates. Many found it difficult to start however, with much confusion over area and capacity formulae. Others found the process very straightforward, substituting the y from the rearranged capacity formula, $120 = 3x^2 y$, into the surface area formula $A = 3x^2 + 8xy$ to produce the required answer $A = 3x^2 + \dfrac{320}{x}$

For those who reached this answer, or one that was of a similar form, it was a simple task of differentiating, setting the result $= 0$ and solving to find the value for x. Part (c) was more of a challenge. It required candidates to prove that the value of x produced a minimum value for A.

As a result of the formula not being given in part (a), the question proved to be very discriminating, with many weaker candidates struggling to score many marks. For those candidates who made significant progress, marks were dropped as a result of;

- Slips when writing down area formulae resulting in incorrect vales for P and Q

- Taking a square root rather than a cube root when solving $x^3 = \dfrac{160}{3}$

- Failing to write correct notation, $\dfrac{d^2 A}{dx^2}$, or a correct reason, $\dfrac{d^2 A}{dx^2} > 0$, when attempting to prove part (c)

Question 4

This question involved solving simultaneous equations within the context of geometric series. Most candidates who were familiar with the topic were able to write down two correct equations, $\dfrac{a}{1-r} = 75$ and $\dfrac{a\left(1 - r^3\right)}{1 - r} = 70.2$ without any great difficulty. This was as far as some could go, as they failed to find any route of solving this type of equations. Those candidates

who spotted the common '$\dfrac{a}{1-r}$' in both equations, it was a simple task of writing down and solving $75\left(1-r^3\right)=70.2$.

A number of people who gave up via this method then re started and wrote down an alternative set of equations, this time $\dfrac{a}{1-r}=75$ and $a+ar+ar^2=70.2$. Generally, candidates found this pair easier to combine, although the resulting quartic equation in r proved more demanding to solve. There were plenty of successes however and many achieved full marks via this route.

Once the value of r had been found via an acceptable method, most were able to find the value of a.

Question 5

This was a fairly routine question on the remainder and factor theorem and many well-rehearsed candidates scored full marks here.

Part (a) involved using the fact that $f\left(\dfrac{4}{3}\right)=0$ to show that $16a+9b=56$. It is very important when solving such questions to show all necessary lines in the solution. Whilst most candidates achieved both marks, marks were lost when the '$=0$' appeared too late in a solution or could only be implied by a line of working.

Part (b) caused some difficulty. As 'b' was the remainder when $(x-2)$ was divided into the function, candidates should have set $f(2)=b$ leading to an equation in just 'a'. It was then a simple task of solving this, substituting the resulting value into the given $16a+9b=56$ and finding a value for 'b'. Unfortunately, many unwary candidates used an incorrect method. set $f(2)=0$ and solved a pair of simultaneous equations in a and b.

Given the fact that $(3x-4)$ was a factor, candidates should have started part (c) by dividing or factorising $(3x-4)$ out of $f(x)$. It was then a relatively straightforward task of factorising the resulting quadratic to form the factorised expression. There were a number of candidates who used their calculators inappropriately to find the roots of $f(x)$ and then wrote down a factorised

expression without any just working. As use of algebra was required, these candidates failed to score marks in this part.

Question 6

Question 6 was based around the geometry of the circle and there were many excellent solutions.

In part (a) candidates were required to find the perpendicular bisector of AB. Most knew the method and were able to score two or more marks here. A suprising number of candidates made slips on finding the mid-point of the line.

Part (b) was a follow through mark and gained by almost all candidates who had an answer for part (a).

Part (c) was a good test of finding the equation of a circle. Most candidates were able to find the radius by finding the distance from the centre to either A or B. It was then standard bookwork to use the equation $(x-7)^2 + (y-'k')^2 = r^2$. Errors seen here included;

- Wrongly assuming that ABP was a right-angled triangle
- Using AB^2 as the radius^2 of the circle
- Not simplifying $\left(4\sqrt{5}\right)^2$

Question 7

Part (i) was a novel way of testing the trapezium rule via logarithms. Many candidates knew the form of the trapezium rule and were able to score the B mark. Quite a sizeable number then resorted to using a calculator, writing down the value 4.003…., and then attempting $10^{4.003}$ to find k. Unfortunately, this was not allowed via the scheme. Candidates needed to use the laws of logs to simplify their expression to reach $\log 10080$

In part (ii), candidates were on more familiar ground. It was a straightforward test for those who knew and could apply the laws of logs. Marks were lost mainly as a result of;

- Not rejecting 20 as a possible solution

- Making algebraic slips when simplifying $\dfrac{(5-a)^2}{(a+25)} = 5$

- Not showing all steps in the solution as required by the question

Question 8

This question, on two different types of proof, allowed higher achieving candidates to show their skills.

In part (i) a large number of candidates did not seem to know the difference between rational and irrational numbers. Many of these assumed that rational numbers were fractions as there were many answers that were similar to $\dfrac{3}{4} \times \dfrac{4}{3} = 1$, hence proven. Most correct answers were variations on the one in the main mark scheme, namely showing $\sqrt{2} \times \sqrt{8} = 4$.

Part (ii) was quite demanding. Most candidates who made progress used the form of an odd number as $n = 2k+1$. Substituting this into $n^3 + 3n + 2$ produced a cubic expression which could then be put in a form which showed that it was always even, but never a multiple of 4. Marks were lost mainly as a result of one of;

- Using $n = 2n+1$
- Incorrectly simplifying $(2k+1)^3 + 3(2k+1) + 2$
- Using the form $n = 4k+1$ for the odd numbers

If candidates formed the correct simplified expression for $(2k+1)^3 + 3(2k+1) + 2$, many were able to produce accurate and eloquent reasons to prove the given statement.

Question 9

This question was another that had the bold warnings

In this question you must show all stages of your working.

Solutions relying entirely on calculator technology are not acceptable.

Candidates should be well advised to heed these warnings as failure to do so results in a loss of marks.

In part (a) candidates were required to use calculus (i.e. differentiation) to find the coordinates of the maximum point. Most expanded the given expression into a sum of two terms and differentiated each one before setting $= 0$. Although the technique was well known many errors crept in. These included

- writing $x^2 \sqrt{x}$ as $x^{\frac{3}{2}}$

- an inability to solve an equation of the form $18x - \frac{9}{2}x^{\frac{3}{2}} = 0$

- correctly finding $x^{\frac{1}{2}} = 4$ but incorrectly concluding that x was 2

Part (b) was found equally challenging. Many candidates chose to multiply out the expression and solve with $y = 0$, failing to realise that the form given, $\dfrac{9x^2 \left(5 - \sqrt{x}\right)}{5} = 0$, was the most suitable one to use. Simply stating that $5 - \sqrt{x} = 0$, so $x = 25$ was seen much fewer times than expected.

In part (c) most candidates knew they needed to integrate their two-term expression and use the area of a rectangle somehow. Errors were common in this part too, namely:

- using limits of 0 and 25 rather than 16 and 25

- failure to correctly integrate the second term to $\dfrac{18}{35}x^{\frac{7}{2}}$

- using a calculator to find $\displaystyle\int_{16}^{25} 9x^2 - \frac{9}{5}x^{\frac{5}{2}}\,dx$ with no integration seen

As with other earlier demanding questions, there were some excellent solutions to this question where high achieving careful candidates produced accurate and well written solutions.

Question 10

This proved to be a suitable last question.

The first part required candidates to prove $\cos\theta\left(3\tan\theta+\dfrac{2}{\tan\theta}\right)\equiv\sin\theta+\dfrac{2}{\sin\theta}$

It is important in a proof that candidates start with the left- hand side of the identity and not a version of it. Using both identities $\tan\theta\equiv\dfrac{\sin\theta}{\cos\theta}$ and $\cos^2\theta\equiv 1-\sin^2\theta$ it was possible to reach the right-hand side in around 5 steps. The main reasons for a loss of marks here were;

- writing $\sin\theta$ as sin without the θ
- Failure to show all stages in the proof

Part (b) was very accessible and many scored 4 marks here without having achieved all 4 marks in part (a). Most candidates were able to use the given identity to find the correct quadratic equation in $\sin x$. Solving it and finding suitable values of x in the range 0 to 2π, proved more demanding with many only finding one of the required values.