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Examiners' Report
October 2025

International Advanced Level in Pure Mathematics P2
WMA12/01

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General Comments

This WMA12_01 paper proved to be a very good test of the specification. Questions 1, 2, 3, 4 and 6a proved to be a very good source of marks for all learners with the rest of the examination paper providing differentiation at all grades. The paper was of appropriate length with little evidence of learners rushing to complete the paper.

Points to note for future exams are

- Learners should show their method when presenting solutions as just writing down answers, especially when incorrect, can prevent attainment of marks.
- Learners should write down all appropriate steps when working towards given answers as well as writing down clear reasons when asked to justify results

Question 1

This was a very accessible start to the paper for many learners, a significant proportion of which scored all the available marks.

The common errors for those learners who did not score full marks were;

- using a common difference as '3' rather than '-3'
- misunderstanding the formulae most notably via inaccurate bracketing. E.g. in part (a) 78 + (18 – 1) – 3 was commonly seen followed by an incorrect '92'
- using an incorrect formula, e.g. $S_n = \frac{n}{2}\{a + (n-1)d\}$ seen numerous times
- changing the correct answer in (b) of -7050 to 7050

Question 2

This was another very accessible question with again, many learners scoring full marks. The most common reasons for not scoring all available marks here were;

- appearing to find the question challenging, merely expanding $(1+px)^{10}$ to $1+10px+45p^2x^2+120p^3x^3+\ldots$
- not showing ability to square and cube values of *p* and reach 45×*p* =67.5 for *q* and 120×*p* = 180 for *r*

Question 3

This provided more of a test for learners. Parts (a) and (b) were fairly standard but part (c) required much thought.

In part (a) learners were required to use logs to solve the given equation. Many managed this, with most deciding to divide 300 000 by 3 before taking either $\log_2$ or $\log_{10}$ of each side. The two main reasons why learners did not score both marks were;

- multiplying the 2 and the 3 together and attempting to solve $6^{-k}=300\,000$
- giving the answer as –16.6 or 16.61 instead of –16.61

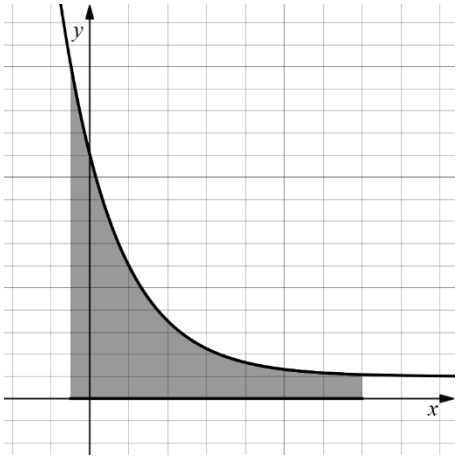
Part (b) tested the trapezium rule via a given table of values. This produced many fully correct answers as well as the occasional errors using incorrect values of *h* as well as not using correct bracketing. These two errors were very common;

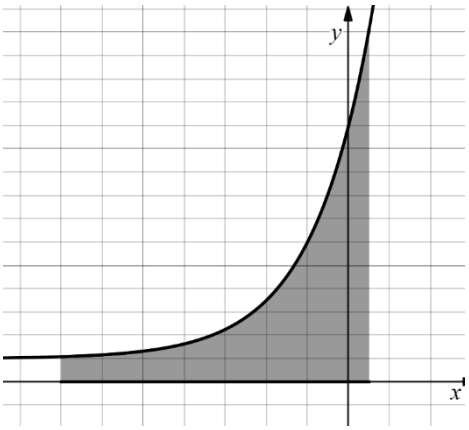
- finding *h* via the calculation $\frac{7-(-0.5)}{6}$ rather than just spotting *x* differences of 1.5
- finding $\frac{1.5}{2}\{4.243+0.023\}+2(1.5+0.530+0.188+0.066)$ rather than $\frac{1.5}{2}\{4.243+0.023+2(1.5+0.530+0.188+0.066)\}$

Part (c) involved realising both of the following;

(1) that $\int_{-0.5}^{7} 2^{-x}\,\mathrm{d}x$ was $\frac{1}{3}\times\left(\int_{-0.5}^{7} 3\times 2^{-x}\,\mathrm{d}x\right)$ and (2) $\int_{-7}^{0.5} 2^{x}\,\mathrm{d}x$ is equal to $\int_{-0.5}^{7} 2^{-x}\,\mathrm{d}x$

Most learners knew fact 1 but not 2. The easiest way to justify this is via the area under the curves.





Question 4

This question was based around the cubic function $\mathrm{f}(x)=4x^3+13x^2-10x+8$

Part (a) was generally well attempted with many choosing to divide the function by $(x-2)$. Apart from errors in division, many learners were able to successfully manage this and isolate both the quotient and the remainder. Of those learners who attempted the question but did not gain full marks, the most common reasons were;

- writing down the quotient as $\left(4x^2+21x+32\right)(x-2)$
- not acknowledging the quotient aspect and just finding the remainder via $\mathrm{f}(2)$

Part (b) involved two proofs. In part (i) the factor theorem was used to prove that $(x+4)$ is a factor of $f(x)$. Learners were required to substitute $x=-4$ into $f(x)$, show that it equalled 0, and then conclude that $(x+4)$ is indeed a factor. In part (ii) they were required to show that $f(x)$ only had one root. To do this the quadratic factor had to be found by dividing $f(x)$ by $(x+4)$. The quadratic factor should then be shown to have no roots, resulting in the only root of $f(x)=0$ being $x=-4$. Common errors in part (b) were;

- writing down $f(-4)=0$ without giving the evidence
- not concluding that $(x+4)$ is a factor of $f(x)$
- believing that the quadratic factor was $4x^2+21x+32$, the same function as in part (a)
- giving incorrect reasons for the quadratic factor $4x^2-3x+2$ having no roots, e.g. it doesn't factorise
- making incorrect conclusions e.g. the only root is $(x+4)$

Question 5

This question involved solving two trigonometric equations. Fully correct solutions were rare with many learners not making significant progress in one or both parts.

Use of the identity $\tan\theta=\frac{\sin\theta}{\cos\theta}$ was key to solving the equation in part (i). Whilst most knew and used this identity, progress was dependent upon use of algebra leading to either of the following equations, $\sin\theta(4+5\cos\theta)=0$ or else $5\cos\theta=-4$. Once one of these were reached, 4 or 5 marks tended to follow. Many learners however chose to approach the question by:

- either multiplying throughout by $\sin\theta$ leading eventually to a cubic equation in $\cos\theta$

- or else attempting to square leading to a quartic equation $\sin\theta$

rather than using a route through the equation from $4\frac{\sin\theta}{\cos\theta}+5\sin\theta=0$.

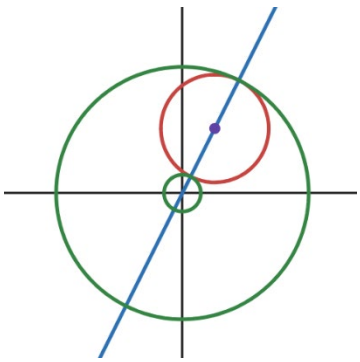
Whilst both of these routes were possible, they were far more demanding than the one given in the main scheme. Of those who chose the main scheme route, many did not obtain a correct solution resulting from $\sin\theta=0$ due to cancelling by $\sin\theta$, and not factoring it out.

Part (ii) was equally discriminating. The key here was to multiply throughout by $\sin x\cos x$, and via the identity $\sin^2 x+\cos^2 x=1$, arrive at the simple equation $5\sin x=1$. If these steps were attempted, fully correct solutions were common. Marks were not gained in instances where there was a lack of accuracy or only giving one of the two solutions.

Question 6

Most learners made a valid attempt in finding the equation of the circle in part (a) with many of these being fully correct. Common mistakes made by learners not scoring 5 marks were;

- mixing up radius and diameter
- making numerical errors when finding the midpoint of *AB* or distance *AO*



Part (b) was demanding and showed the value of using a sketch to aid the solution of a problem. There were many complicated algebraic approaches attempted via intersections of lines and curves but correct solutions were often accompanied by a diagram similar to the one on the left-hand side. The 'red' circle from part (a) had centre $(6,12)$ and radius 10. Its centre is

therefore a distance of $\sqrt{6^2+12^2}=6\sqrt{5}$ from the origin. Hence the two 'green' circles have radii of $6\sqrt{5}+10$ and $6\sqrt{5}-10$ respectively. The centres of both of these circles is the origin.

This part proved to be very discriminating and success here showed a high degree of problem solving.

Question 7

This question involved applications of calculus in respect of turning points and area under a curve.

Parts (a) and (b) involved differentiation and used the fact that *T* was a minimum turning point. The ideas used were fairly standard but the constant *k* seemed challenging for some. Full marks were common, but marks were sometimes not obtained for the following reasons;

- $kx^{\frac{1}{2}}$ being differentiated to $\frac{1}{2}k^{-\frac{1}{2}}$
- a lack of evidence in part (b) with $3\times81-10\times27-\frac{k}{6}+28=0$ being followed by the given answer with no intermediate working.

Part (c) was more demanding due to the fact that the area was below the *x*-axis. Most learners knew that integration was required and hence scored the first 3 marks. Finding the shaded area involved subtracting the area between the curve and the *x*-axis away from the area of the rectangle. As both of these under the *x*-axis meant that occasionally areas were added instead of subtracted. Another very common error was in finding the area of the rectangle via the calculation 44×9 instead of 53×9. Fully correct solutions were rare but most learners did show an appreciation on the method involved and picked up useful marks in this question.

Question 8

This proved to be a very discriminating question on geometric sequences and series.

Part (i) involved proving the formula $S_n = \frac{a(1-r^n)}{(1-r)}$. As with other proofs on this paper, it was important for learners to show all key steps. The starting point needed to be an expression for S_n with at least 3 correct terms, including the first and last terms. From there, an expression for rS_n could be found which would lead to the desired result via $rS_n - S_n$. Fully correct proofs were rare with common errors for learners scoring at least the 1st of the 3 marks being;

- reversing the series S_n and attempting the proof via the arithmetic series route
- making errors on terms when attempting rS_n, for example having a last term of ar^{n+1}
- having incorrect lines such as a penultimate line of $S_n - rS_n = a + ar^n$

Part (ii) was set in context with marks only available to those learners who could establish the fact that an 8% reduction per year meant that the value of *r* was 0.92. If this was found then part (a) tended to be approached via the calculation $150 \times (0.92)^6$ leading to the answer 90.95. Part (b) was perhaps the most demanding aspect of the paper. Fully correct solutions were rare, but learners who knew that the sum of a geometric series was required tended to score at least one mark for using appropriate values of *a*, *r* and *n*. Learners who used a logical approach and wrote down

End of Year One = 150×0.92^1, End of Year Two = $150 \times 0.92^2 + 150 \times 0.92^1$ etc could extrapolate the result to 'End of Year 40 = $150 \times \frac{0.92(1-0.92^{40})}{(1-0.92)}$,

Question 9

Whilst part (i) was a standard log question, part (ii) required both understanding as well as problem-solving skills.

Part (i) was a useful source of marks for many learners. Careful responses could use standard log rules to combine terms, remove the logs and then solve the resulting quadratic equation. Common reasons for not gaining full marks here were;

- writing down incorrect log laws. E.g.

$$2\log_3(4x+5)-\log_3(x+3)=\frac{\log_3(4x+5)^2}{\log_3(x+3)}$$

- not multiplying out $(4x+5)^2$ correctly
- not dismissing the solution $x=-2$

Part (ii) appeared to be an unfamiliar question for everyone. The proof, in the first part, required careful use of logs as well as solid algebraic skills. Many learners made initial errors by writing $\log(a+b)$ as log *a* + log *b*. For those who made the correct first step, deducing that $ab=a+b$, common reasons for losing marks were;

- omitting steps when proceeding to a given result
- omitting brackets on the first line e.g. writing $\log(a+b)$ as $\log a+b$

Many learners who did not complete the proof of $a=\frac{b}{b-1}$ in part (a) were able to score one of the two marks in (b). The most common way this was scored was by stating that $b\neq 1$ as that would make *a* undefined. The correct restriction and reason was that '$b>1$ as *a* must be positive'. Sight of this was a sign of a very strong response.