Examiners' Report
Principal Examiner Feedback

October 2024

Pearson Edexcel International Advanced Level
In Pure Mathematics (WMA13) Paper 01

Report of Principal Examiner
October 2024

Specification/Module/Unit Title: IAL Maths	
Specification/Module/Unit Number: WMA13	Paper Number: 01
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Immediately all marking has been completed, Examiners are asked to forward a report to the Principal Examiner on this form. Such reports need not be lengthy but they should provide the Principal Examiner with information that will be useful in compiling the report on the examination. Examiners are asked to follow the guidelines on this form as set out below.

(a) **The response of candidates to particular questions**

Although it may not be necessary to comment upon each question in the paper, this section will form the most important part of the Assistant Examiner's report. At the Standardisation meeting, the Principal Examiner will indicate any questions on which you will be particularly required to report. In the report, the numbers of the questions should be clearly shown. The comments should be as meaningful as possible, and the following should be avoided as examples of bad practice:

Question 1 *Satisfactory*
Question 2 *Not so well done*
Question 3 *Badly done*
Question 4 *Some good answers*
Or *Some good candidates attempted question 1*

These comments should be contrasted with the following report which is considered to be informative and helpful:

Many candidates' responses to questions relating to the impact of agriculture on the environment had been influenced by the 'green' *movement. At one level a simplistic view of farmers as exploiters prevailed. At other levels, the realisation that science applied to agriculture had made a great contribution to the provision of cheap food was more apparent. At all levels great concern for the environment was shown and candidates were familiar with such terms as 'greenhouse effect', 'ozone layer, and 'organic farming'. However the knowledge and understanding of these terms was often incomplete.*

(b) **Popularity**

Comments on the popularity of any questions should be given in a separate section unless Examiners are asked to complete a question popularity analysis.

(c) **Administration**

Any observations on administrative matters relating to the conduct of the examiners should be given in a separate paragraph which will be conveyed by the Principal Examiner to the Assessment Leader.

(d) **Mark/Grade Boundaries**

The Principal Examiner may ask Examiners to give their view on certain mark/grade boundaries for that part of the examination that they have marked. If such a request is made, the suggestion should be given in the appropriate table provided on page 4 of this form.

This WMA13_01 paper was a suitable test of the specifications for a prepared candidate. The paper was of appropriate length with little evidence of students rushing to complete the paper.

There were no questions that proved too demanding for the majority of students.

Points to note for future exams mainly revolve around these two sentences.

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

Solutions relying entirely on calculator technology are not acceptable.

For ALL questions, candidates should make their methods clear. Where questions start with the two bold sentences shown above, it should be a warning that using calculators to solve complex equations will result in the loss of marks. It is also vital to show the necessary steps on the way to solving the problem.

Question 1

This represented an appropriate start to the paper with the straightforward use of an identity to solve a trigonometric equation. The vast majority of candidates achieved either a correct quadratic in sec x, or in cos x and proceeded to find both solutions to an appropriate degree of accuracy. Errors were seen in a minority of scripts but a loss of marks could be attributed to one of the following;

- Use of an incorrect identity, usually $\tan^2\theta = \sec^2\theta + 1$ or $\sec\theta = \tan\theta + 1$
- Omission of the second angle $250.5°$

Most candidates presented their solutions appropriately and showed sufficient steps to make their methods clear.

Question 2

This question on the link between $\frac{dy}{dx}$ and $\frac{dx}{dy}$ proved more demanding than expected.

Part (a) was usually well attempted with the majority of candidates differentiating with respect to y and then reciprocating their result to find the solution. Candidates who were unaware of the difference between $\frac{dy}{dx}$ and $\frac{dx}{dy}$ were unlikely to achieve any success.

It is important to note that whilst many candidates achieved the answer of $\left(-\frac{73}{8}, -\frac{5}{4}\right)$ not all of these scored the 3 marks in part (b). Accuracy (A) marks can only be achieved via a correct method. The correct method could only be achieved via setting $\frac{\mathrm{d}x}{\mathrm{d}y} = 4y + 5$ equal to zero. From there it was an easy task to find the correct coordinates. Unfortunately, many candidates set $\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{1}{4y+5}$ equal to zero and followed this up with $4y + 5 = 0$. This scored 0 marks as it was an incorrect assumption followed by incorrect processing of the equation.

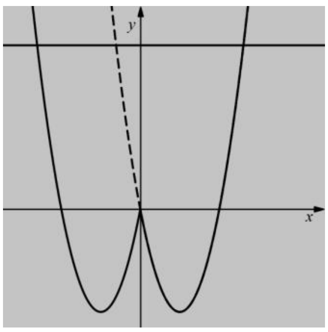
There were other correct methods seen in part (b), most notably using the symmetry of the curve. These marks were independent of part (a) and candidates could score 0 marks in (a) followed by 3 marks in (b).

<u>Question 3</u>

This question on modulus graphs and equations also proved to be rather more challenging than might have been expected

In both parts of the question, candidates would have benefitted if they had sketched the relevant curve. They also need to appreciate that when they are instructed to show all stages of working a safe approach is to show each individual step/process one at a time.

In part (a) they were required to solve $\mathrm{f}\left(|x|\right) = 48$



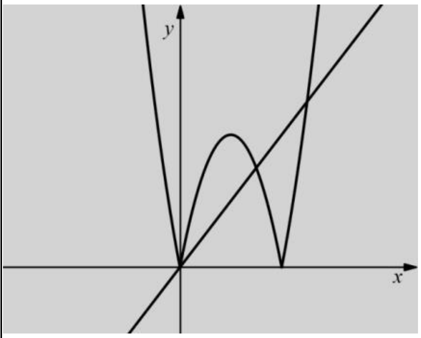
The sketch on the left-hand side shows that there are just two solutions, which are symmetrical about the *y*-axis.

A very high proportion of candidates attempted to solve an appropriate quadratic equation, mostly $2x^2 - 10x = 48$ via the intermediate steps of $x^2 - 5x - 24 = 0 \Rightarrow (x-8)(x+3) = 0 \Rightarrow x = 8, -3$.

Many then just ignored the -3 , due presumably to the fact that it was a modulus equation, and only achieved one of the two answers.

Others candidates achieved 4 answers $x = \pm 8, \pm 3$.

Candidates who drew a sketch were able to pick out the true solutions of $+8$ and -8, In part (b), candidates were required to solve the inequality $|\mathrm{f}(x)| \geqslant \frac{5}{2}x$



Using the sketch on the left, candidates were required to find the values of *x* for which the curve is 'above' the line.

Virtually all candidates attempted to solve a correct equation or inequality. The mark scheme required that full working be shown including the collection of terms before writing down an answer. **Failure to do so meant that all four marks were lost.**
The demand of the question was that working must be shown!

Having achieved the two critical values $x = 15/4$ and $x = 25/4$ by no means guaranteed full success in this part. Many wrote down $0 \leqslant x \leqslant \frac{15}{4}$ or $x \geqslant \frac{25}{4}$ instead of $x \leqslant \frac{15}{4}$ or $x \geqslant \frac{25}{4}$

<u>Question 4</u>

This question on logarithmic functions was generally well attempted.
In part (a) the correct initial number was nearly always found.
In part (b), candidates were expected **to show that** $\log_{10} N = 0.35t + 2$ could be written in the form $N = ab^t$. The demand meant that some intermediate work was expected and not just written statements for *a* and *b*. The majority of candidates heeded the warning and many eloquent proofs were seen.

Part (c) was far more discriminating with many candidates not appearing to know how to differentiate such a function. Quite often the answer 5640 was seen, which is the value of *N* at 5, not the value of $\frac{\mathrm{d}N}{\mathrm{d}t}$ at 5.

Other incorrect attempts involved $N = 100 \times 2.24^t \Rightarrow \frac{\mathrm{d}N}{\mathrm{d}t} = 100t \times 2.24^{t-1}$

Question 5

Part (a) required candidates to show that $\sin 3x$ could be written in the form $P\sin x + Q\sin^3 x$.

This was answered well by the majority of candidates with many achieving all four marks.

By writing $\sin 3x$ as $\sin(2x + x) \equiv \sin 2x\cos x + \cos 2x\sin x$, careful use of the double angle identities and $\cos^2 x \equiv 1 - \sin^2 x$ led the well - prepared candidate to the correct form of the answer.

Of those candidates who did not achieve all 4 marks, marks were generally lost for;

- Incorrect identities being used for cos2*x*
- Slips in notation and/or bracketing errors

Part (b) was again well answered well but only a small proportion of candidates succeeded in scoring all four marks. Most of these lost their mark for failing to spot the solutions that resulted from setting $\sin\theta = 0$.

Most candidates used the result from part (a), factorised or cancelled out a factor of $\sin\theta$ reaching the equation $6 - 8\sin^2\theta = 10\cos\theta$. Use of the identity $\sin^2\theta \equiv 1 - \cos^2\theta$ would then set up a 3 term quadratic equation in $\cos\theta$ which could be easily solved. Other reasons for losing marks in part (b) were;

- Slips in coefficients when multiplying out brackets
- Overcomplicating the equation by attempting to square $6\sin\theta - 8\sin^3\theta = 10\sin\theta\sqrt{1-\sin^2\theta}$, often unsuccessfully

Question 6

This question on functions was very well done.

In part (a), candidates were asked to find $\mathrm{gf}(2)$. Most found f (2) first and then applied g to the result. There were very few incorrect solutions to this part.

Part (b) asked candidates to find f^{-1}, the inverse function to f. Most candidates knew they were required to change the subject of the formula $y = 6 - \dfrac{21}{2x+3}$ with the majority of these attempts being successful. To fully define a function (or in this case an inverse function) you require both an equation and a domain. In keeping with previous examination series, the mark for finding the domain was not scored by many, with lots of candidates unaware that it should be calculated.

In part (c) candidates were asked to solve the equation gg (x) =126. Most candidates knew how to start this and many scored at least 2 out of the 3 marks. Some overcomplicated the solution by setting up an equation in x^4. A simpler more direct solution could be obtained by the following.

$$\left(x^2+5\right)^2+5=126 \Rightarrow x^2+5=\sqrt{121} \Rightarrow x^2=6 \Rightarrow x=\pm\sqrt{6}$$

Question 7

This question was based around the turning points of $y = \mathrm{f}(x)$ where $\mathrm{f}(x) = x^3\sqrt{4x+7}$

Part (a) asked candidates to find the gradient function $\mathrm{f}'(x)$ in a given form. Most candidates knew the product rule of differentiation, carrying it out to a high degree of accuracy. The last two marks, scored for giving $\mathrm{f}'(x)$ in a factorised form were more discriminating.

In part (b), almost all candidates scored marks here. As the form of part (a) was given, it was accessible even to those who had not succeeded in part (a).

Part (c) was also well done with many candidates scoring at least one mark for multiplying their y coordinate in part (b) by ± 4. The most common reason for losing the accuracy mark was having an incorrect inequality sign with $\mathrm{g}(x) < \dfrac{27}{2}$ regularly seen.

Part (d), on transformation geometry, was pleasingly well done with a very high proportion of candidates achieving both marks.

Question 8

This penultimate question proved challenging to some. It was set within the context of the heart rate of a horse which was modelled by an exponential equation.

Part (a), finding the initial heart rate, was generally well done.

Part (b), the long-term heart rate was found more demanding than part (a), but still attempted successfully by many candidates

Part (c) required candidates to find the time at which the heart rate was a maximum. Nearly all candidates knew to differentiate and most did this correctly. The two next steps, the algebraic manipulation of two exponential terms and the subsequent solution of a simplified equation were a stumbling block. Many weaker candidates gave up after the attempted differentiation and others took logs at too early a stage. There were some excellent solutions however with fewer than usual arithmetical errors or slips. The question paper contained the warning that solutions based upon calculator technology were unacceptable. Hence solutions such as
$-8\,e^{-0.2t}+18\,e^{-0.9t}=0 \Rightarrow t=1.158$ only scored the marks for correct differentiation.

The proof in part (d) proved demanding. Many candidates failed to score the M mark as they did not realise that the first step in solving the problem was to make $e^{-0.2t}$ the subject of the formula. Other candidates found showing each step of working clearly difficult. Hence scores of 2 out of 2 in this part were less common than expected.

Part (e) involved the use of the iterative formula to find t_2 and the value of M. As with previous examinations, candidates scored highly on this topic with most scoring at least two marks on this part.

Question 9

In part (a) most candidates were able to apply the quotient rule correctly. The majority of these went on to form the correct simplified expression for $f'(x)$ although the expansion of the brackets did cause some difficulty to the unwary.

The proof in part (b) was also successfully done by the majority of candidates. The given answer helped some candidates check their answer to part (a) and it was clear that some went back and corrected their previous attempt. As this was a proof, it was vital that all logical calculations and steps were required to be seen

Part (c) more of a challenge with a number of candidates appearing unfamiliar with handling fractions, especially in long division. Those that found the values of A, B and D by inspection or other algebraic methods tended to be more successful. A common error in this part was to find the remainder as –3/2. A more serious error was to terminate the division early leaving $\left(x-2\right)$ as the remainder.

The calculation of the area in part (d) was an appropriate challenge this late in the paper. It was pleasing to see the number of fully correct solutions. Common errors leading to a loss of marks were;

- integrating their $\int \frac{k}{2x+1}\,\mathrm{d}x$ term to $k\ln(2x+1)$ or $\frac{k}{2}\ln(x+1)$
- applying incorrect limits to their integral, notably 1/3 and 106/5 as opposed to 1/3 and 2
- a failure to add on the area of the triangle
- incorrect simplification of the ln terms

Comments on Administrative Matters (if any)

- Thank you to my team leaders and examiners who did a wonderful job in bringing this examination in on time and marked to a very high standard.
- Thank you to Clare and all at IAL Maths who were extremely efficient in helping me run the pre-standardisation meetings and ensuring the marking of the examination was efficient, accurate and swift.