Pearson

Edexcel

Examiners' Report

Principal Examiner Feedback

January 2022

Pearson Edexcel International A Level

In Pure Mathematics (WMA13/01)

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General

This was a fairly typical WMA13 paper. There were plenty of very accessible early questions, with many of the later questions, especially from question 7 onwards, written to test the best of candidates. Generally the standard of algebra was sound. Presentation could be greatly improved in the setting out of a proof. It was noticeable in this series that many candidates omitted important lines when proceeding to the given solution resulting in the loss of some vital marks.

Report on individual questions

Question 1

This question was answered well by most candidates with many scoring full marks. Most candidates recognised that the expression to be differentiated was a product and were able to apply the appropriate method, with just a few forgetting to multiply by the 3 in the differential of the exponential term.

Almost all candidates knew to then set their differential to zero and although most went on to then solve this in a correct manner, a few stopped and offered no further work. Although a few candidates then made arithmetic errors in solving their equation most did either cancel out the exponential terms or factorise them out before going on to solve the linear equation. A small number of candidates believed that setting the exponential term to zero gave them another answer – usually incorrectly giving zero as a second solution. Careful reading of the question should have alerted them to there being only the one solution.

Question 2

Most candidates were well prepared for this question.

In part (a), even some of the weakest candidates were able to earn a mark for stating the identity cosec θ = 1/ sin θ despite making little or no further progress. Occasionally, candidates struggled writing cosec θ = 1/ cos θ or sometimes 3 cosecθ = 1/ 3sinθ. Most candidates however progressed well with this question with many scoring full marks in both parts of the question.

In part (b), most candidates were able to undertake the correct order of operations in order to solve the equation and find the smallest positive solution. Sometimes however, candidates did not divide by 2, leaving their answer as 48.59…° Others gave their answer in radians, presumably not checking the setting on their calculator. It is worth noting that some candidates proceeded to find more than one solution, before going on to reject the larger solution. This was of course not incorrect but was something of a waste of time. Those who didn't reject the second solution lost the accuracy mark which was even more of a shame. Candidates should be advised to take care to read the question carefully to determine what is being asked of them.

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Question 3

In part(i), a small number of candidates confused integration with differentiation resulting in expressions in of the form $a(2x\text{-}5)^{6}$. The vast majority however were able to recognise that $(2x\text{-}5)^{7}$ integrated to a form $k(2x\text{-}5)^{8}$. It was not uncommon for slips in the calculation of the correct coefficient (1/16) and weaker candidates often obtained 1/8 instead. Most candidates integrated here by recognition rather than by substitution. Although candidates who employed substitution here and again in part (ii) were usually successful. Disappointingly, a substantial number of candidates neglected to include the constant of integration and were penalised with the accuracy mark.

Part (ii) was more challenging and as a result the spread of marks was far more varied. Some candidates seemed at a loss of how to proceed with an integration of this form. Some integrated numerator and denominator separately, others attempted to use a 'quotient rule' of sorts and others incorrectly attempted to split the integrand into $a \sin x + b \tan x$ all such approaches which were given no credit.

Those candidates who did recognise that the integral was of the form $\int \frac{f'(x)}{f(x)} dx$ with a result of the form $a \ln\left(f(x)\right)$ usually made good progress. It was fairly common though to see a multiplier of +2 rather than -2 in the result of the integration. Quite a significant proportion of candidates used substitution to tackle this integration (usually $u = 1+\cos x$ but sometimes $u = \cos x$) and many were successful. Most candidates using substitution kept their limits in terms of x, undoing their substitution before applying the limits of the integration and subtracting. Finding the answer in terms of a single ln was usually well known.

Question 4

Most candidates scored well on this question.

In part (a) the majority replaced A with 30 and t with 0 and showed sufficient working – as is required in a "show that" question – to achieve the given value for p. Very occasionally there was a candidate who did not know they needed to replace t with zero or did not recognise that e^0 was 1 and were thus unable to proceed.

Part (b) was answered well with most candidates able to rearrange the equation in a correct manner before taking logs to achieve the value of T. A few candidates attempted to take logs before having rearranged the equation into a suitable form demonstrating a poor understanding of the necessary processes to solve this type of equation.

In part (c) although many candidates deduced the correct value for the maximum area, only about half of them remembered that when giving an answer for a real-life situation, they needed to also state the units as part of their answer.

Question 5

The responses to this question produced a wide range of marks.

In part (a) a good proportion knew to substitute the two given values into the given expression and they usually achieved correct values. The fact that one value was negative and the other positive was recognised and a relevant comment made to that fact but often there was a failure to also comment on the fact that the function was continuous or there was no relevant conclusive remark about there being a root between the two given values.

In part (b) most candidates were confident in applying the iterative formula and scored well although occasionally the answer to part (ii) was not to the required accuracy.

In part (c) the need to differentiate the expression was appreciated by most of the candidates. A few forgot to multiply by the "2" being the differential of the "$2x+3$". There were a number of candidates who could not differentiate the logarithmic term into a correct format. Generally, candidates then correctly set their differential to zero and attempted to solve their equation via a quadratic. It was pleasing that most who had got this far then rejected the negative solution and just quoted the positive value as their answer.

Question 6

(a) The majority who recognised the need to differentiate and apply the quotient rule generally did well, and most of these achieved a term of the form $k / (x-4)^2$ at least. There were quite a number of errors in simplifying the numerator, with the 'negative bracket' being the main issue. Some chose to use the product rule, but many of these failed to derive the required form and this in turn prevented them from deducing that $f'(x) < 0$. Most of those who obtained the correct derivative went on to state the correct reason that $f(x)$ is decreasing. Some knew that their derivative was negative but failed to write out a satisfactory conclusion. A significant number of those who scored no marks attempted to demonstrate the answer by substitution of multiple values into their $f(x)$ - but this can score no marks due to the infinite number of x-values, any one of which could be larger than the previous!

In (b), again, candidates were generally well prepared for the technical challenge of rearrangement to show the inverse function. However, a majority of candidates were not aware that the domain was required, and therefore by far the most common score seen was 2/3.

(c) (i) Most candidates also knew how to find $ff(x)$ and could write down the unsimplified answer. Errors at this stage were few and far between but did include the usual loss of terms. The method of simplifying the complex fraction into the form given in the question was less well known. Bracketing errors did mean that a number of candidates failed to achieve full marks.

(c) (ii) This was the most demanding part of the question and it was rare to see both marks being awarded. Many realised that 22 was significant, but thought that ff(x) >22, losing the potential mark. Very few stated 5 as a significant value. Many thought that ff(x) >4.

Question 7

(a) There were many correct solutions here. Errors seen included only writing down just the x coordinate or else having a y coordinate of -5 as opposed to -10, presumably found by incorrectly using the 1/2.

Part (b) was found to be very demanding by many. Candidates who attempted to rearrange to make | 2x+7 | the subject often made errors due to the fractional terms. Those who didn't, struggled to cope with both aspects of the inequality. Only the best candidates managed to obtain both critical values and proceed to select the outer region with correct inequality work. Common errors seen included

- incorrectly "removing" the modulus on $\frac{1}{2}|2x+7|-10=\frac{1}{3}x+1$ to solve $\frac{1}{2}(-2x+7)-10=\frac{1}{3}x+1$
- incorrectly solving $-\frac{4}{3}x\geqslant\frac{29}{2}$ to give $x\geqslant-\frac{87}{8}$ rather than $x\leqslant-\frac{87}{8}$

Part (c) also proved difficult. Most who sketched out a new graph managed to produce a W shape. Finding the local maximum point was also well done although occasional errors were seen when candidates made both coordinates positive. Solutions scoring all 4 marks were rare with marks generally lost for

- using the solutions from (b) for the local minima
- attempting to adapt/overwrite the given Figure 2 to answer part (c) and showing just an upturned V

Question 8

In part (a), many candidates were able to find the correct values for either p or q or both. However, this was not always accompanied by sufficient working to award full marks for a “proof”. Some candidates stated simply $x=550\times1.2^{-t}$ with no (or very little) working and were penalised with the final accuracy mark. Candidates should be reminded to set out all stages of their working in ‘show that’ questions. In this case, evidence of a minimum manipulation of powers or logs (depending on the starting point chosen) was required as evidence of method. To this end, we required: $\log_{10}x=2.74-0.079t$ to be written as $x=10^{2.74}\times10^{-0.079t}$ or even better $x=10^{2.74}\times\left(10^{0.079}\right)^{-t}$ Alternatively: $x=pq^{-t}$ to be written as $\log_{10}x=\log_{10}p-t\log_{10}q$ followed by setting $\log_{10}p=2.74$ and $\log_{10}q=0.079$

Some candidates managed to find their way to a correct value for p and q via one or more steps involving dubious or incorrect use of logarithms or indices. For example, $x = 10^{2.74} + 10^{-0.079t}$ or $\log_{10} x = \log_{10} 2.74 \div t \log_{10} 0.079$ were seen regularly.

In general, finding the value for p was often more successful than finding the value for q. Although there were very occasionally some rounding issues with candidates stating $p = 549$ rather than 550.

In (b) a majority of candidates understood that p was the 'initial' value of antibiotic once the dose had been administered; however some candidates lost this mark due to difficulty conveying this accurately.

In (c) the mark profile was more varied, with some students failing to realise differentiation was required, and a significant number failing to differentiate using the appropriate result thus scoring 0/3. Common errors were to miss off the negative sign and treated the t as a constant power and subtracting 1 from it (this incorrect method achieved no marks for this part). Very few candidates scored 1/3 here, with the majority of those who could differentiate $y = a^{kx}$ either achieving 2/3 (losing the negative in their derivative) or all 3 marks.

Question 9

Most candidates used the substitution $\sec^2 x = 1 + \tan^2 x$, and which almost always lead to the correct quadratic in tan x. Errors were often made by not cancelling the 2's in the equation. Use of alternative substitutions were not very successful, simply because the result was far more difficult to simplify. Most candidates achieved the required solutions of tan $x = 3/2$ and tan $x = 0$ after successful factorisation of their equation. Unfortunately tan $x = 0$ was often dismissed as having no solution or only '$x = 0$' at that stage. Most candidates worked in radians, it was rare to see both solutions in degrees. The answer of 0.983 was frequently stated. Some lost the accuracy mark by truncating this to 0.98, or giving an alternative solution, perhaps from $\pi - 0.983$

(ii) There was a wide range of solutions to this part of the question. Many would have spent far more than the time allocation for it. Despite the lengthy methods employed, many were successful in proving the identity. A relatively small number employed the most concise solution after following the golden rule of putting over a common denominator first (as in the mark scheme). Some employed identities for sin3 θ and cos3 θ, though this was relatively rare. Most tended to use the identities for $\sin(2\theta + \theta)$ and $\cos(2\theta + \theta)$. There were more identities required for these longer proofs and, consequently , some candidates lost their way and gave up. Identities for sin2 θ and cos2 θ were used well alongside $\sin^2\theta + \cos^2\theta = 1$.

Question 10

(a) Many candidates spotted the product rule aspect of the ye^{2y} but struggled with the fact that it was an expression in y and not x. Hence many attempts at differentiation had $\frac{dy}{dx}$ rather than $\frac{dx}{dy}$ on the left hand side and resulting proofs at the given answer were fudged. Other candidates took lns of both sides in an attempt to make y the subject. It is important that candidates show all aspects of a proof and many good candidates lost marks here for merely writing down the given answer from a correct $\frac{dx}{dy}$ without any intermediate lines.

There were lots of blank solutions to part (b). It was a discriminating question at the A/A* boundary with candidates needing to deduce that the left hand side of the curve can be found from a solution of $1+2y=0$. Candidates who spotted this generally went on to score 2 of the 3 marks with the final mark being lost for an inaccurate solution or incorrect range.