Examiners' Report/
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Pearson Edexcel International A Level in Mathematics C34 (WMA02) Paper 01

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Core Mathematics C34 (WMA02)

General Introduction

This paper was the first Core 34 paper from the new IAL specification. It contained a mixture of straightforward questions that tested the candidates' ability to perform routine tasks, as well as some more challenging and unstructured questions that tested the most able candidates. Most candidates were able to apply their knowledge on questions 1, 2, 4 5, 7, 8 and 10. Timing did not seem to be a problem as most candidates seemed to finish the paper. Questions 3, 6, 9, 11 and 12 required a deeper level of understanding. Overall the level of algebra was pleasing. Points that could be addressed for future exams is the lack of explanation given by some candidates in questions involving proof. It is also useful to quote a formula before using it. Examples of this are when using the product rule and quotient rules in differentiation, or indeed by parts in integration.

Comments on Individual Questions:

Question 1

Most candidates attempted this question (successfully) using the Quotient Rule. Many did not state the rule and a small proportion confused u and v. Those who applied the Product Rule were mostly successful, despite the greater amount of work involved. Marks lost were, for the most part, due to failure to apply either rule. Almost all candidates set the numerator of their $f'(x) > 0$. There were some who failed to reverse the inequality when multiplying through by -1. Most found two critical values and most of these were the correct two values. There was a small proportion who found only one critical value, namely $\sqrt{3}$.

Question 2

In general the question was well done, with many candidates scoring full marks. Most candidates spotted the equivalence to $\tan(2x + 50)$ and proceeded with the correct order of operations to find at least one correct answer. Most candidates did give their answers to 2 decimal places as required. Some candidates thought there would be just two answers thus losing the final accuracy mark. Candidates who did not use $\tan(2x + 50)$ but chose to rearrange to make $\tan 2x$ the subject of the equation were also usually very successful.

Question 3

The majority of candidates made good progress with part (a), equally divided in their methods between the "comparing coefficients" and the "long division" approach. Some confused the order of the letters, although they clearly had the figures in the correct place. A few found A and B, and then just stated the values of C and D as 17 and 8 respectively. In part (b) many candidates restarted and used long division to obtain the required form, even though they had obtained the result needed in part (a). Some could integrate both parts efficiently, but a considerable number tried to use partial fractions, "factorising" the denominator into $(x^2 + 2)(x^2 - 2)$. Those who obtained an integrand containing logs were generally able to manipulate it correctly when they put in the limits. Part (b) and the integration of $\int \frac{x}{x^2+1}\,\mathrm{d}x$ was a huge challenge to some.

Question 4

Part (a) was extremely well done by most candidates who worked in the correct order and substituted their value to g(1) into f and gained both marks. A few candidates lost the A mark by giving two answers often due to the modulus of a function having a positive and negative result. Some candidates carelessly worked out g(1) incorrectly within their expression for fg(1) and so lost a mark. In part (b) most candidates worked out g(0) = 3 or left it as $\frac{9}{3}$ to gain the method mark. Very few candidates found the limit of g(x) as x tends to infinity, and so failed to find correctly the other end of the interval for the range and so did not earn the accuracy mark. Very many candidates gave the lower end of the interval for the range as zero.

In part (c) the majority of candidates obtained the inverse function of g in an appropriate form and achieved a follow-through mark from their domain in part (b) to gain full marks Very few candidates found the correct domain. Of those candidates who did find the correct domain, many had surprisingly not obtained the correct range in part (b). A number of candidates expressed their domain in terms of $\mathrm{g}^{-1}(x)$ and so lost this mark.

Only the more able candidates scored all three marks in part (d) of the question. Many candidates found either or both of the values 5 and 11, often without showing any method. Those candidates who proceeded by equating f(x) to k, removing the modulus sign, giving rise to two equations and then attempting to solve to give k in terms of x, failed to gain any marks at all. The point behind this part of the question was to test candidates ability to equate the shape of a function f(x) to the number of roots of the equation f(x) = k.

Question 5

Many candidates found part (a) difficult, with many poor attempts and many more leaving it out altogether. Those that did know what they were doing usually achieved full marks using the main method in the mark scheme.

In part (b) most candidates demonstrated sound skills in implicit differentiation with many achieving full marks. When differentiating some candidates ignored the RHS or left out the ln 2 but most were able to use part (a). Candidates were then able to proceed by rearranging their differential. Most rearranged first before substituting in their values, when putting in the values first would have been an easier route. The method to find the equation of the tangent was almost always correct.

Question 6

This question on the binomial expansion was quite demanding but was generally carried out very well, especially by the most able candidates. In part (a) most candidates took out a factor of $9^{\frac{1}{2}}$ correctly and combined this with 6 to achieve a factor of 2. There were surprisingly few errors with the expansion itself. Only a small number of candidates used a power of $\frac{1}{2}$, or even -1, for the binomial expansion. A good proportion of candidates did handle the $\frac{A}{9}$ term using correct bracketing. A high percentage of candidates achieved $B = 2$ and of those, almost all went on to get $A = 6$. There were rather more problems with finding the value of C. Of those candidates who did not reach the value $\frac{1}{3}$ for C, many did score a method mark which was accessible to those who had an incorrect value for A. It was surprising that, although a high proportion of candidates had a correct unsimplified expansion, many failed to simplify correctly. In particular, too many lost sight of the need to square A and hence gained an incorrect C. In part (b) those who completed part (a) fairly successfully, nearly all gained a correct term in x^6. Common errors were to lose the factor of 2 from the front of the expansion or to forget the minus sign.

Question 7

In part (a) most candidates knew the product rule and used it very successfully to find $f'(x)$. The methods were divided equally between those who combined $2x(1 + x) = 2x + 2x^2$ before using the rule once, and those who performed the rule twice on $2x \ln x$ and $2x^2 \ln x$. A minority used the quotient rule and some integrated by parts.

Again most did part (b) well. A few didn't rearrange the equation correctly with errors on either bracketing or problems with the minus sign. As this was a proof all aspects needed to be correct at each stage of the process.

Part (c) was attempted by nearly all, most achieving full marks. Some lost marks by ignoring the minus sign thus achieving incorrect values.

Part (d) was often ignored or incomplete. Many candidates were so used to having to justify the root was correct to 2 decimal places, they attempted this even though it wasn't the focus of the question. Many did repeated iterations. Having put all their efforts into this they failed to find the y value or failed to write the x correct to 2 decimal places. Those that did answer this correctly then managed to get both values.

Question 8

Most candidates were able to score good marks on this question.

In part (a) many candidates recognised the need to show detailed steps when asked to prove a given result and most followed the most direct method in doing so. The first mark for replacing 2 cosec $2A$ was scored by almost all candidates. Equally, the large majority of candidates were able to replace sin $2A$ correctly.

There were some errors in the process of combining two fractions into one fraction, but again this was generally well done. The most common gap in proofs was the failure to write down $\frac{\sin A}{\cos A}$ before proceeding to tan A.

In part (b)(i) a significant proportion of candidates failed to make the connection with part(a). Of those candidates who recognised that tan $2\theta = \sqrt{3}$, most went on to score both marks. Some lost the accuracy mark by giving the value of θ as 30°. Another common reason for losing the accuracy mark was the presence of a second answer within the range.

In (ii), those candidates who recognised the link with part (a) generally proceeded to score all four marks for this part of the question. Some did lose marks for answers to less than the required degree of accuracy.

A number of candidates replaced tan θ by $\frac{\sin\theta}{\cos\theta}$ and cot θ by $\frac{\cos\theta}{\sin\theta}$ and proceeded to reach sin $2\theta = \frac{2}{5}$. These candidates were then able to score all four marks.

Question 9

Question 9 was found to be a testing question, producing a wide range of responses. Strong candidates were able to score most marks available whilst weaker ones struggled to pick up 2 or 3. In Part (a) some candidates substituted and integrated successfully but left the answer in terms of 'u' instead of the required x. Many candidates, however, had problems finding $\frac{\mathrm{d}u}{\mathrm{d}x}$ and made numerous errors when attempting to express the result in terms of 'u'. When they did get an integral in terms of 'u' there were poor attempts at the integration. The integration of $\int \frac{1}{u}(-8+2u)\,\mathrm{d}u$ was carried out correctly only by the stronger candidates.

In part (b) a number of candidates merely stated that $h > 0$ (or $h \geq 0$). As in Q1, some had difficulty in handling the inequality and found $\sqrt{h} > 4$. A few knew that it was something to do with $h = 16$ but did not attempt an inequality.

In part (c) most gained the first mark for separating the variables correctly – some leaving '20' on the left hand side. Many more errors were made for the first method mark. Many tried to integrate without reference to the result from part (a). Some did use that result but left it in terms of 'u'.

Integrating $\frac{1}{20}\,\mathrm{d}t$ was very successful, as might be expected. Those who began with a valid method usually went on to find a constant term or alternatively used the correct limits. Of those who had left the part (a) answer in terms of 'u', most replaced that answer in the integral with one in terms of 'x', before substituting x for 'h'. A few who used $2u - 8 \ln u$, changed the limits appropriately and mostly successfully. Even candidates who had (correctly) proceeded this far often failed to get the final answer 118 years. Very few candidates scored full marks on part (c).

Many candidates made several attempts at parts (a) and (c).

Question 10

Most candidates knew how to tackle part (a), although using $2\mathbf{i}$ rather than $2\mathbf{j}$ in equation of line 2 was a common error in forming the equations. However many candidates failed to check that their values satisfied all three equations, so did not fully establish that the lines intersected. Some explicitly showed that their third equation balanced, and others that their values of λ and μ both led to the same coordinate.

In part (b) the majority knew that they needed the scalar product, although some failed to use the direction component of the lines. Some candidates just stated that the scalar product was zero without showing any working as evidence. There were also many who correctly showed that the scalar product was zero, but failed to give a conclusion.

Part (c) was generally the least successfully attempted part of the question. Those candidates who attempted a solution using the method in the mark scheme made some progress, although many got the wrong direction and ended up back at A. A more successful approach was to take X as the midpoint of AB leading to $\frac{5+x}{2} = -3$ etc. Many candidates worked out the distance AX; a few of these then succeeded in correctly forming and solving a quadratic equation for λ, and selecting the solution which gave the point B. However several candidates who tried this method assumed that B was on the line 2, so made no progress. Overall though, question 10 was a useful source of marks for many candidates.

Question 11

Most candidates were successful on the first two parts of the question, although part (c) was found to be more demanding. A modest number of candidates lost the mark by giving 't' in degrees in part (a) rather than in radians. Some also gave more than one value of 't' including negative values having failed to consider the fact that point A has positive coordinates.

In part (b) most candidates were able to obtain the correct expression for $\frac{\mathrm{d}y}{\mathrm{d}x}$ and substitute their value of 't' (even when found in degrees) to obtain a numerical value for the tangent gradient. Almost all candidates used the negative reciprocal of their tangent gradient correctly to obtain their normal gradient and used this in an appropriate form of the normal equation. A few candidates obtained a Cartesian form of the equation of the curve and differentiated (successfully in most cases) to obtain the gradient function

In part (c) about equal numbers of candidates followed each of the methods shown on the main scheme. Those candidates who obtained a quadratic equation in $\sin t$ tended to be more successful with their manipulations. Attempts at solving the resulting 3TQ = 0 were generally correct. There were many careless mistakes, including arithmetic ones, in moving from a value of $\sin t$ or 't' to finding the coordinates of B. A number of candidates gave rounded values for their coordinates of B, despite exact values being required by the question.

Question 12

This question was challenging and gave the opportunity for the most able candidates to excel. In part (a) most candidates seemed able to write down the formula for the volume of revolution but many of the candidates failed to show the limits and many were equally lax with regard to the 'dx'. Such candidates lost the final accuracy mark. Too many candidates do not appreciate that when an answer is given they must be very thorough and not leave out any stages of the proof. The key to this part of the question was to expand $(\sin x + \cos x)^2$ which most candidates did, but a significant minority mistakenly arrived at $1 + 2 \sin 2x$.

Unsurprisingly, many candidates had difficulty with part (b) this question. Candidates who split the integral and integrated separately the x^2 and the $x^2 \sin 2x$ were generally more successful than those who chose to take x^2 and $(1 + \sin 2x)$ as the two components for integration by parts. Candidates tended not to simplify terms as they were working through the question so mistakes with plus and minus signs were quite common. Equally factors of 2 or $\frac{1}{2}$ similarly tended to go astray. A key to success in a question of this complexity is to present working carefully. The final method mark was for substituting in both limits and then subtracting. Candidates need to demonstrate clearly that they are doing this, not least when the lower limit in an integration is 0. Some candidates did become careless and the '$2x$' did sometimes become just 'x' part way through the question. Of those candidates who reached an answer for the volume, almost all responded to the requirements of the question and sought to give an exact answer.

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