Examiners' Report
Principal Examiner Feedback

October 2017

Pearson Edexcel International A Level
In Core Mathematics C34 (WMA02/01)

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IAL Mathematics Unit Core C34

Specification WMA02/01

General introduction

Many students seemed to have been well prepared for this examination although, as evidenced by a significant number of blank responses, there appeared to be some students who were not ready or prepared for this paper. That said, some excellent scripts were seen and those who were well prepared, the paper proved to be accessible. Timing did not seem to be an issue either, with prepared students able to complete the paper.

Some questions and parts of questions proved to be challenging. In particular, 6(c)/(d), 8, 9, 11 and 12(d) discriminated well.

It was clear in some cases that students sometimes are not showing enough work in "show that" questions. This was evident in 1(a) and 4(a) where examiners were occasionally left to "fill in the gaps" when important steps were omitted.

Question 1

(a) This was answered well by most students, with a minority losing the final mark for not being quite thorough enough. $f(x) = 0$ was sometimes missed at the start, and some students missed out a crucial algebraic step, such as showing the factorisation on the LHS, which in a 'proof' will not gain full marks. Some missed the "3" in front of the root symbol. Only a very few did the reverse method.

(b) Most students just wrote down the three required iterative results, correctly. Some showed their working, but this was not essential. A minority forgot they were to use the cube root, and used the square root instead, losing all three marks.

(c) Most knew what interval to use and generally substituted the boundaries correctly into $f(x)$. The conclusion was sometimes missed, with some not indicating (in some way) a 'change of sign'. There was a significant minority who substituted boundaries into the iterative equation, or just continued with the iterative process from (b), gaining no marks.

Question 2

(a) Most students realised that the product rule was needed for the x^2y term and were able to differentiate this successfully. Many students also gained M1A1 for differentiating y^3 with respect to x correctly to obtain the "$3y^2\text{d}y/\text{d}x - 6 = 0$". Those with correct differentiation could almost always proceed to rearrange to obtain a correct $\text{d}y/\text{d}x$. The most common error in part (a) was the failure to apply the product rule.

(b) The majority of students realised that they needed to set the numerator equal to zero although a significant number of students equated the denominator to zero. Some even equated the numerator to the denominator. Those who had a numerator in terms of x and y and could make progress in this part although a few stopped at $2xy = 6$, presumably not knowing how to proceed from there. Most substituted $y = 3/x$ or $x = 3/y$ into the given equation to achieve an equation in x or y only. Many reached $x^4 = 9$ or $y^4 = 9$ and a small number carried out both procedures to find the values of x and then y, rather than using $y = 3/x$ having solved for x.

The final A mark was lost by some as the (often correct) values were left un-simplified as e.g. leaving $\sqrt{3}$ as $\sqrt[4]{9}$. There were some who failed to find the negative values of x or y and so ended up with one point rather than two. It was pleasing to see that many grouped the coordinates in brackets.

Question 3

(a) Most knew that 3500 was the value required. The only mistakes were from those putting $t = 1$ into $N = 3500(1.035)^t$

(b) Most students gained the first two marks although occasionally BODMAS rules were misapplied, with students writing $\{(3500\times1.035)^n =\}\ 3622.5^n = 20/7$, forfeiting these first two marks. Many were also successful in getting to $t = 30.516\ldots$ hours, with various correct uses of logarithmic approaches. The most common error was getting from there to the correct number of hours and minutes, as requested. Some rounded to 30.5 and obtained 30 hours and 30 minutes, losing the final mark. Some converted to 1831 minutes, losing the final mark. Occasionally an answer of 30 hours and 52 minutes was given, suggesting 100 minutes in an hour.

(c) The requirement to 'Use Calculus' was not followed by a significant minority who just worked out N when t was 8, or divided that number by 8. Those who correctly differentiated almost always got an acceptable answer. Those who incorrectly differentiated N, usually to $3500t(1.035)^{t-1}$, and then put $t = 8$ could only gain one method mark for this part.

Question 4

(a) A variety of routes were used here to converting $\cos 2x$, most achieving the numerator of $2\sin^2 x$. Those who did not gain all three marks, in general, were those who reached $\tan x$ too quickly, failing to give details of cancelling or writing $\sin x/\cos x$ before the final statement.

(b) Very few failed to replace $(1 - \cos 2\theta)/\sin 2\theta$ with $\tan\theta$. However, although most were successful, there was more difficulty in replacing $\sec^2\theta$ with $1 + \tan^2\theta$. Sign errors occurred and there were several examples of attempts to replace $\tan\theta$ with $\sec\theta - 1$. Although most used the method outlined by the mark scheme there were several ingenious methods seen. Some students found the correct 2 possible values of $\tan\theta$ but decided that $\tan\theta = -1$ was not appropriate. Very few left the final angles in degrees, although those who did often failed to give sufficient accuracy, using 3 significant figures rather than 3 decimal places.

Question 5

(i) The majority managed to increase the power by 1, most leaving the answer as $(3x+5)^{10}/30$. Some left the 30 as 3x10, which still gained the A mark. Some omitted the factor '3'. The B mark was gained by most students although in a few cases, it appeared that the exponential term was differentiated.

(ii) Most students managed to integrate to give either $\frac{1}{2}\ln(x^2 + 5)$ or an equivalent expression if they used integration by substitution. Some, who used integration by substitution forgot to change their limits. Many managed to deal with the lns successfully although there was some variety in attempts to simplify the equation in terms of b and unsuccessful responses were often those where, with 3 terms in ln, the lns were cancelled like a common factor. Also, $\ln A - \ln B = (\ln A)/\ln B$ was seen several times. Most rejected $b = -7$ and many simply did not mention the negative value.

Question 6

(a) The correct answer was almost always found. Errors were from some who had too few decimal places, while others incorrectly used degrees in their calculation.

(b) The correct answer was again almost always found. A few used $h = \pi/5$ by mistake, using the formula incorrectly rather than looking at the table, and a few got the structure of the trapezium rule incorrect. A small minority did not use the 'trapezium rule', but worked out separate trapezia, and were often successful, though penalised themselves with the time taken.

(c) Most used the product rule, but many found the expression complicated to differentiate. Those using the product rule often got one of the terms correct, usually the $-2e^{-x}\sqrt{(\sin x)}$ term, but not the other term. The most common error was to have $e^{-x} (\cos x)^{-0.5}$ instead of the required term $e^{-x} (\sin x)^{-0.5}\cos x$. Some also missed the "–" when differentiating the e term. A minority used the quotient rule successfully. There was a large minority whose use of powers on the trigonometric expressions was poor. Many 'corrected themselves' later when reverting to square root signs, but those who left their answers with incorrect terms (for example $\sin x^{0.5}$) were penalised.

(d) This was often not attempted. When attempted, most recognised the need to eliminate the e term after setting their answer to zero, but manipulating the correct gradient expression with $\sqrt{(\sin x)}$ terms proved difficult for some. However many got to the required $\tan x = ½$ and to the correct answer, some by more complicated methods than necessary. Those who had not scored full marks in (c) usually scored no marks in

(d). The requirement to get from their gradient = 0 to an expression of the form $A\cos x = B\sin x$, or equivalent, was almost impossible with 'correct' algebra from an incorrect gradient. A numerical error or a sign error in

(c) enabled some to get marks in (d), but any error in indices in (c) usually resulted in no marks in (d).

Question 7

(a) Almost all found the factor '1/8' although some students took out a factor of 2 without compensating for the power of –3. Most wrote down the binomial expansion with index ' –3' although some simplified the second term as '$9x/2$'. Numerical errors arose from the third term and this was usually due to failing to square the 3/2. Part (a) was a good source of marks for many students.

Parts b) and c) were not generally very successfully attempted. Although some students were clearly familiar with this type of question, there were many who seemed to have little idea what to do and often did not attempt it. A considerable number equated their expression to 0, and there were quite a number of students who multiplied their expansion by $(4 + kx)$ correctly but then collected terms badly. For example, there were several instances of $(108 + 9k)$ becoming $117k$.

Question 8

As no assistance was given in the question to the structure of the partial fractions, a large number of students incorrectly used just $A/x + B/(x - 1)$ when $A/x + B/(x - 1) + C$ was required. These students could still score 5 of the 8 marks with no more errors. With so few types of partial fraction on the specification, this ought to have been straightforward. The clue in the question that the answer had to be in the form 'a + ln*b*' did not appear to alert those who successfully got to ln(128/81). Division was more popular than using the identity for those correctly using $A/x + B/(x - 1) + C$, with the constant 2 being found most of the time by either method. The remainder of $2x - 3$ from division was also usually found correctly. Some who used just $A/x + B/(x - 1)$ found A to be 3 and B to be '$2x - 3$' and often went on to find the fully correct $2 + 3/x - 1/(x - 1)$. The integration was usually correct as was the substitution of 4 and 3, but a significant minority could not combine any of their multiple "ln" terms together to score the final method mark.

Question 9

(a) Many students knew the shape of the logarithmic graph, but the positioning was sometimes incorrect. Many had the asymptote in the wrong position, and very few labelled it even when it appeared correct. Many also failed to find or mark the intersection with the x-axis.
The majority knew how to obtain the modulus graph, although some reflected in the y-axis and some translated as well as reflecting.

(b) Many students found at least one solution here and some found both, even if they had not sketched a correct graph. The second M1A1 were sometimes lost by there being no attempt or for an incorrect initial statement. Many students thought that $\ln x = 0$ did not have a solution.

In part (c) most students substituted for gf in the correct order, but there were frequent errors in attempting to simplify the result and a large number of students were unable to obtain a correctly simplified expression.

In part (d) the most common error was not giving a strict inequality and $y \geq -2$ was frequently seen.

Question 10

(a) This part of the question was usually handled well with the vast majority of students scoring both marks. Most saw that $t = 4$ was required, and almost all substituted to find $x = 80/9$. A very few thought that '$x = 4$' was the answer, or stopped at $t = 4$.

(b) Differentiation was usually very good, with the quotient rule the most popular for $\mathrm{d}x/\mathrm{d}t$. The chain rule was also applied well and students seemed very familiar with combining both of their derivatives in order to obtain an expression for $\mathrm{d}y/\mathrm{d}x$ and they were usually able to obtain a correct expression. The format of the answer was given on the question paper, and most got to it. The most common error was to leave their final answer with $2t - 4$ on the numerator and 20 on the denominator.

(ci) This part was competently answered by the vast majority. However some less able students struggled as the parameter t was present in two terms of the equation and there were instances where students omitted to make the t a common factor of the 2 terms in order to successfully rearrange the equation.

(cii) Most substituted their t expression for x into $y = t(t - 4)$ to gain the first mark. The question stated that the Cartesian equation should be written as a single fraction and there were some responses which failed to make progress in this respect. Students attempting to adapt the second fraction to create a common denominator were often able to successfully obtain a fully correct form of the Cartesian equation. However, it was common to see slips occurring as a consequence of either sign errors or losing the power of 2 on the denominator.

A large number of students either forgot to find k or did not know how to, as their answers often ended with their expression for y. Those who did attempt to find k usually got the correct answer, but some guessed it was $k = 80/9$, using their answer from (a). There were some students that correctly used their denominator to realise that x could not take the value 10 but failed to score the mark for not stating either the domain or alternatively the value of k.

Question 11

Students found this question challenging.

Most managed the first differentiation in part (a), but many did not manage to substitute correctly for dh and thus could not complete the integration correctly. Of those who could progress to obtaining an expression they could integrate, most split the fraction correctly but some opted to use integration by parts on $(-10+2u)/u$ and success was variable. Many lost the final A mark for either assuming that $k = 10$ or for, otherwise correct answers, which did not realise or imply that their $c + 10$ was the required k.

In part (c), most separated the variables correctly with some leaving the '5' with dh and some leaving it with dt. A few failed to use the result from part (a) but most quoted this, with or without '+ 10'. Some forgot to increase the power of 't' and a few confused this integration resulting in $t^{0.2}/\ln 0.2$. Many gained the M mark for substituting $t = 0$ and $h = 2$ and most gained the M mark for substituting $h = 15$. However, some incorrectly used the value $h = 13$. A small number of students opted for definite integration. Having made significant progress, a number of students had difficulty in solving for 't' after reaching '$t^{1.2} = \ldots$'

(c) In general, the method used was correct but due to earlier errors, many students were unable to access this mark.

Question 12

(a) (2, 0, 7) was usually correctly 'written down', as requested, though a minority insisted on solving the two equations simultaneously, even though there was only 1 mark for part (a).

(b) Most realised that the scalar product would get to $\cos\theta$, and it was pleasing to see almost all were using the two direction vectors. There was only a small minority of students who used position vectors of points, or the same point (2, 0, 7). Most therefore got to $\cos\theta = 1/3$, and most of them used a triangle or an identity to get to the required exact value of $\sin\theta$. A small minority ignored the suggested format of the answer and gave a decimal equivalent.

(c) There were many fully correct solutions here. Often the simplest method of finding $AB = 4\times 3 = 12$ was missed, so longer methods of e.g. finding point B, vector **AB** and then length AB from Pythagoras were used instead. Some misused $AC = 2AB$ to get $AC = 6$. Some had an incorrect AB but correctly used $AC = 2AB$ to gain the second M mark with a correct attempt at the area of the triangle.

(d) As expected, this part produced much fewer correct solutions and often no marks at all were scored. The three A marks were immediately lost if AC was incorrect from (c), and this was quite common. Those who realised that C was on l_2 usually scored some marks. It is recommended that students use a diagram in vector coordinate geometry questions. Finding μ to be $\pm 8/3$ was most often achieved by using the length of the direction vector in $l_2 = AC$, but most unnecessarily used $(8\mu)^2 + (4\mu)^2 + (\mu)^2 = AC^2$ to get to μ. The positive μ value could have been spotted by dividing their AC (= 24) by the magnitude of the direction vector of l_2 from (b) (= 9), but few saw this. Those who got to the correct values of μ usually got full marks for finding the two points C could be, although some made substitution errors. The use of **OC** = **OA** ± 2**AB** was often seen leading to no marks.

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