Pearson

Examiners' Report
Principal Examiner Feedback

January 2017

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

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This paper was the fourth January Core 34 paper from the IAL specification. It contained a mixture of straightforward questions that tested the students ability to perform routine tasks, as well as some more challenging and unstructured questions that tested more able students. Most students were able to apply their knowledge on questions 1,2, 3, 4, 5, 7, 8, 10, 11 and 13. Timing did not seem to be a problem as most students seemed to finish the paper. Questions 6, 9, 12, 13d and 14 required a deeper level of understanding. Overall the level of algebra was pleasing. Points that could be addressed in future exams is the lack of explanation given by some students in questions such as 2a, 8a and 9a involving proof. It is also useful to sketch a diagram when attempting a question on vectors. (See comments on Qu 14)

Comments on Individual Questions:

Question 1

This question on implicit differentiation was attempted by nearly all students with almost 60% scoring full marks. The need for the use of the product rule was appreciated by most students. A surprisingly frequent error made by students in this question was in forgetting to differentiate the constant term of 37. The other common error was in not applying the product rule to $3x^2y$ which was often differentiated to $6x\frac{\mathrm{d}y}{\mathrm{d}x}$. Students who had differentiated correctly and who decided to make $\frac{\mathrm{d}y}{\mathrm{d}x}$ the subject of the formula sometimes made basic mistakes with signs when re-arranging. It would have been safer to substitute numerical values first and then re-arrange. The overwhelming majority of students chose to use the $y-a=m(x-b)$ form of the straight line equation. There were a few students who attempted the equation of the normal rather than the tangent. A final mark was lost by some who either missed the requirement to produce the answer in a specific form or made errors in expanding the brackets.

Question 2

The mean mark for this question was 5.4 out of 7.

(a) This was a straightforward part and most responses were fully correct. However, a number did fail to satisfy the demand of the question. Of these some failed to start with the statement f(x) =0 or equivalent whilst others merely wrote down $x=\sqrt[3]{5x-16}$ without an intermediate line. A small number also made arithmetic errors which then affected their chances in part (b).

(b) This part was done very well with many obtaining the correct values for the results of the iterations. A minority did not work to the required accuracy and occasionally the third value was given as -3.170 losing the final A1.

(c) Most students chose a suitable interval and made at least one correct attempt to evaluate f(x) thereby gaining the first M mark. For the second A mark three things were required namely both evaluations correct to 1 sf (rounded or truncated), a sign change stated and a conclusion. Sign change indicated by " >0 and <0" following calculations was acceptable as was a negative product of the values. The requirement for the conclusion was minimal yet many lost this A mark through omission of either the second or third requirement Both marks were lost by students who chose too wide a range e.g [-3.18, -3.16] or else continued with the iteration in their attempt to prove that $\alpha=-3.17$ to 2d.p.

Question 3
The vast majority of students scored well in this question with a mean mark of 7 out of 9 with almost 50% scoring full marks.

(a) Errors in part (a) were rare but usually occurred on the numerator of the $\frac{B}{3+2x}$ term with the substitution of $x=-\frac{3}{2}$ into their expression.

(b) Most students also presented good solutions to (b) with many correct expansions. Of those who made mistakes the many came from an incorrect coefficient of one of the two expansions. or more frequently the inability to use the coefficient of -3 throughout the second expansion. Only a minority did not recognise how to use their answer to part (a) and made no attempt at part (b).It was pleasing that any responses were clearly set out with the two expansions found separately and combined at the end.

Question 4
The mean mark in this question was 6.8 out of 10 with most students dropping marks in either part (a) or part (d).

(a) This part caused the most difficulty. Although there were students who scored full marks on this section, the majority scored either 1 or 0. Many students wrote $y<\frac{4}{5}$ but omitted $y>0$. Common answers scoring 0 marks were f(x) > 4/5, considering the domain e.g. 3x+5 = 0 so $x \neq$ -5/3.

(b) This section was very well done with the majority of students getting full marks.

(c) This was also very well done with almost all students scoring the B mark. Although not required for the mark, many students successfully simplified the expression to $\frac{4x}{3+5x}$

(d) Many good students scored full marks in this part. This required a correct equation $\frac{4x}{3+5x}=\frac{3x+5}{4}$, a correct quadratic and a correct conclusion usually via the discriminant.
However, there were many errors seen in an attempt to reach the quadratic. e.g. 4 × 4x = 16 not 16x, 4 × 4x = 8x or writing (3x+5)(3+5x) as $(3x+5)^2$. It is important to remind students of the importance of explaining their method in a 'show that' question. Some students who did completely correct work reaching $b^2-4ac=-576$ did not state that since the discriminant was negative, therefore there were no real roots, so losing the final mark.

Question 5
Another well answered question with a mean of 7 out of 9

(a) This was where a mark was most often lost. This was usually for decimal answers of 4.998 and 3.888 but some students gave both values as $\frac{7\pi\sqrt{2}}{8}$ making the assumption that the graph was symmetrical.

(b) A very high proportion of students scored all three marks, even if they had failed to gain the mark in part (a) The B mark was occasionally lost for a value of $h=\frac{\pi}{5}$, presumably due to the fact that there were 5 ‘x’ values. The M mark for correct trapezium rule structure was almost always awarded. Occasionally the final mark was lost for failing to round the answer to the required accuracy of 4 significant figures.

(c) A large majority of students successfully integrated using parts to gain all 3 marks. Occasionally sign errors appeared.

(d) This part created virtually no problems for the students. However, those students who had $x$sin$x$ – cos$x$ in part (c) could only score the method mark in part (d) despite reaching the value 4π. If (c) was correct then usually so was (d). A handful of students gave the non-exact numerical answer 12.56 and therefore lost the accuracy mark.

Question 6

Another well answered question with a mean of 4.5 out of 6

(i) Nearly all students realised that the Product rule was required here, but a substantial proportion failed to achieve full marks by slipping up on the derivative of ln(3*x*) stating it as either $\frac{3}{x}$ or $\frac{1}{3x}$

Many simplified their answer even though it was not required.

(ii) Most students realised the Quotient rule was required here and there were very few errors in applying it, just occasionally the numerator was written the 'wrong' way around. A few students omitted the brackets when multiplying by *x*. (Hardly any students wrote out the formula or workings). For the majority of students $(\sin x + \cos x)^2$ was expanded fully and correctly. Some, as in question 2 failed to show a complete proof and merely wrote $1 + 2\sin x \cos x$ which went to 1 + sin2*x* losing the mark for sin2*x* + cos2*x* =1

Question 7

This question was found more testing with only very able students scoring high marks. The mean was 4 out of 7 but 20% scored full marks.

(a) The first part of the question was perhaps different from more familiar items on the modular function. The graph was presented and students asked to deduce its identity.

(i)Having been told the form of the function was f(*x*) = |a*x* +b| students were asked to find "all possible values for a and b". Using the given co-ordinates it was straightforward to establish that |b| = 5. This needed to be followed by b = ±5 or b=5 , b= –5. Many responses contained only one value of b despite the hint ("values") in the question and so scored B0. Most were able to deduce that a = (–3) times the value of b by substituting the co-ordinates of P (1/3 , 0) into y= |a*x*+b| and so were able to gain the method mark even if they had given only one value of b earlier. For those students who had obtained two values for each of a and b, in some cases, the correspondence between the pairs of values was unclear and therefore they lost the final mark.

(ii) Many students gave correct modulus equations, some giving both alternatives namely y = | 15*x* – 5| and y = | –15*x* + 5|. Incorrect equations such as y = | 15*x* + 5| or y= |*x*/3 –5| or y = 15*x* +5 were not uncommon. A few gave correct answers using two equations without using the modulus sign together with, for the most part, correct domains for example $y = 15x - 5,\ x \geq \frac{1}{3},\ y = -15x + 5,\ x < \frac{1}{3}$

(b) Students who had performed poorly in part (a) often gained marks in part (b). The new function f(*x*/2) + 3 , required a stretch scale factor 2 in the *x* direction and a translation 3 units in the y direction. The first mark was for a V shape with the vertex above the *x* - axis. Many drew the V shape but had the vertex on the x axis. The mark for the co-ordinates of the vertex was often lost with (1/6, 3) being a common incorrect answer. Many showed the co-ordinates of the vertex by indicating the x and y values on the axes rather than writing co-ordinates and this was acceptable. Most students found the intercept on the y axis correctly for the third mark. Only a few had their graph stopping at the y axis and not crossing it.

Question 8

30% of students scored full marks with a mean mark of 6 (out of 9)

(a) The majority of students recognised that they had to use tan ($3x$) = tan ($2x + x$). The substitution of the double angle tangent formula was successfully carried out in most cases. Many dealt with the fractions as a whole but some separated the numerator and denominator so that the simplifying was less cumbersome. Quite a few (of the weaker) students gave up after applying the double angle formula once. Most attempted to show an intermediate line by multiplying by ($1 - \tan 2x$). Some poor notation was seen but there were some excellent well written concise solutions. A few students lost the final A mark for inconsistent use of variables (mainly A appearing as x).

(b) Most equated the identity with 11tanx before attempting to multiply throughout by ($1 - 3\tan 2x$) to form a cubic/quadratic for tan x. A few wrote $33\tan 2x$ instead of $33\tan 3x$ so that $32\tan 3x = 8\tan x$ was not achieved. Many divided through by $\tan x$ at this stage and failed to achieve $\tan x = 0$ and hence $x = 0$ as a solution. Most students then attempted to factorise their equation and then find a value for x. The majority of students achieved x = awrt 26.6 but many lost the final mark due to not having $x = 0$ or x = awrt –26.6

Many students who 'gave up' on (a) did go on to complete (b) successfully.

Question 9

This was another discriminating question with grade E students averaging 2 marks and grade A students over 8.

(a) Most students were able to change the variable from x to u thus obtaining the correct form of the integral in terms of u. However, a number of students made errors when attempting to simplify these fractions, mostly with the constants but there were a few responses where the u^2 term was erroneously moved to the numerator. The majority of students then realised that they could split the expression to give $\int \frac{1}{4}u^{-1} - \frac{3}{4}u^{-2}\,\mathrm{d}u$ enabling them to integrate the two terms separately. Most were able to correctly integrate the 1/u term but there were sometimes difficulties in integrating the u -2 term and it was not uncommon to see this term resulting in an incorrect lnu2.

The answer to part (a) was given in the wording on the paper and students should ensure that in this type of question they clearly show the limits being substituted and include all stages of working, particularly in simplifying the log terms. Some students attempted to use alternative approaches to deal with $\int \frac{u-3}{4u^2}\,\mathrm{d}u$. The minority who chose to use integration by parts or partial fractions were usually able to apply their method successfully.

(b) This part of the question was usually done well with many students scoring both marks for obtaining the volume by using their answer to (a). There were just a few instances where an incorrect volume formula was used. Common accuracy errors included omitting to square the 9 or omitting the π.

Question 10

This was a very accessible question at all levels with a mean mark of 7.8 out of 10.
Parts (a) and (b) presented little problem to students with very few making errors.
(c) Students seemed at ease with solving an equation involving an exponential and the majority did so very efficiently. The first two marks were gained by a large portion of the candidature, with errors generally to be at the stage when taking logarithms. The majority worked with exact values until the end, some giving the exact value in terms of ln as the solution. However, some students used decimals but not to an acceptable accuracy (e.g. 0.04) and so gained only the method marks. Other fairly common errors were in the algebra in rearranging from the equation $-0.2t = \ln(27/697)$ to $t = -0.2\ln(27/697)$ or in sign slips in the powers (either when rearranging or when taking logarithms). Students tended to score 0 marks when they attempted to take logarithms too early.
Part d proved more challenging with varying degrees of success, and was quite often not attempted at all. Those who did attempt mainly used the chain rule, and were successful in gaining at least the method mark. For those who attempted the quotient rule, many made the error of differentiating the constant 300 to be 1 and so gained extra terms. This was the most common error made in this part. Very few attempted implicit differentiation, but for those who did they were generally successful. There were only a very small minority who included an extra t factor from the power in their derivative, so the idea of e^{kt} differentiating to ke^{kt} seems well understood. It was rare for students who achieved a correct derivative to fail to go on and gain the final accuracy mark.

Question 11

This was another accessible and familiar question to a well-prepared student. Although 20% of students scored full marks, part (c) was very demanding for grade E students.
(a) The value R=37 was usually found without error, but was occasionally given un-simplified as $\sqrt{(1369)}$. Most students were able to score the method mark for finding alpha, although sign errors or having the reciprocal function by mistake did occur. Using R to find alpha, via sin or cos, was surprisingly common. Whilst fine for this example, with a decimal approximation to a non-integer R, errors of accuracy could occur. A minority of students found alpha correctly, but didn't state it to a sufficient degree of accuracy.
(b) Most students were able to make the link between this and part (a) and use their answer to (a) to attempt to solve the equation. The few who didn't make the link were unable to make further progress. The
correct order of operations in solving for x was generally well understood. The main issue with this part was rounding, 2.95 was usually found but 0.85 instead of 0.854 was often seen.
(c)(i) This part of the question seemed to cause more difficulty. Some students attempted to differentiate, usually without success. Others recognised that the function could be rewritten using (a) and could then state the range of the trigonometric component as $-1<\sin(x-\alpha)<1$. However, the reciprocal element caused a lot of confusion, with many students deciding that the minimum must occur at $\sin(x-\alpha)=0$. Where the need for the denominator to be maximum for y to be a minimum was recognised, there were still many errors, with either R being omitted, or with R failing to be squared. When the correct values were put into the equation for y, this was usually calculated correctly.
(c)(ii) When part (i) had been completed correctly, this part usually caused no difficulties, although some students felt the need to set y=5 and solve the whole equation having lost sight of the fact that they knew $\sin(x-\alpha)=1$ from part (c). Obviously, starting from $\sin(x-\alpha)=0$ led to no marks here. Solving $\sin(x-\alpha)= -1$was also very common, and could at least earn a method mark.

Question 12
This question, particularly part (a) was found to be difficult at all levels. The mean mark scored was 1 out of 9 for grade E students and 5 out of 9 for grade A students.
(a) There were many inaccurate or completely blank responses to part (a). Few responses included a clear statement 'x = kt' or 't = cx' . Some students used the number 6 or 20 for t instead of 2 with x = 1.5, getting an incorrect constant. Some started with 2t = 1.5x instead of using the values 2 and 1.5 for t and x respectively. A large minority left the equation as $x = \frac{3t}{4}$ and did not get t in terms of x.
(b) This mark was gained by some who had used the wrong subject for the previous part. A few students who had failed with part (a), intuitively realised the correct value for t and so gained the B mark.
Part (c) was more familiar and the majority of students recognised that they had to separate the variables. Some however separated the variables to give 1/(2x+1) resulting in a ln term. Most achieved t = (x2 + x)/λ and found c = 0 by substituting t = 0 and x = 0. Some failed to include 'c' when integrating or, if they did, subsequently ignored it. A smaller proportion of students attempted the integration of (2x + 1) to give $\frac{(2x+1)^2}{4}$ although some of these divided by 2 instead of 4. Least commonly seen were responses using x = 1.5 and t = 2; this way had more work to find the equation required but most were successful. Quite a few students did not rearrange their equations to give t = … and some did not evaluate the constant of integration and so led to the loss of the final mark.
(c) A few students used in error x = 3 and t = 4 (from part (b), using the simpler model). The value of λ was often stated correctly, even when working in (c) was incomplete or contained errors.
(d) Many students substituted x = 3 and their λ into their expression for t and gained the M mark. Many achieved '6.4 hours' and then failed to find the actual time rather than the time taken. Some attempts at the time were 10.40pm, 10.24 (no pm) all losing the final A mark.

Question 13
This was another discriminating question with (d) being the part where the majority of problems arose. There were a number of cases where little or no progress was made, however, even though the first parts were accessible at this late stage of the paper. The mean score for all students was 7.5 out of 12 with nearly 20% scoring full marks.
In part (a) most students managed to set x = 0 and deduce that $\theta = -\frac{\pi}{6}$ (or −30º), though $\theta = +\frac{\pi}{6}$ was occasionally in evidence They then substituted into y but some did not know that $\sec\theta = \frac{1}{\cos\theta}$ and so were unable to calculate y correctly.
The procedure for finding the derivative in part (b) was shown to be well understood by the majority of students with the first method being obtained by the majority of those who attempted this part. Where it was lost was generally down to a failure to find both derivatives, thinking $\frac{dy}{d\theta}$ was the derivative. Occasionally the division was the wrong way up, or a multiple of the derivatives was used, but this was rare.
However, many students did write down the derivatives of tanθ and secθ correctly, although the use of a variable x was not uncommon, and combine them correctly to yield an expression for $\frac{dy}{dx}$. From there, the majority were able to go on and achieve the correct simplified expression, though there were some who did not appreciate the need to show sufficient working and simply proceeded to the final answer, or jumped from $\frac{\tan\theta}{\sec\theta} = \sin\theta$ or similar. Another common error made was for $\frac{1}{\sqrt{3}\sec^2\theta}$ to be transposed to √3 cos2θ leading to an incorrect value for λ. Overall, however, there were many very well written answers to this part of the question with most students gaining full marks on this part.
Part (c) was a very accessible part, with most students achieving both marks. Even those who did not find a correct solution in (b) were able to use the given answer and realise the value of λ did not

matter. Most managed to solve the equation $\frac{dy}{dx} = 0$ correctly and calculate x and y, though a few did not find both x and y as required.
Part (d) was the most challenging for many students and a significant proportion number failed to score any marks. Students taking the main mark scheme route, who wrote $\tan\theta = \frac{x-1}{\sqrt{3}}$ and $\sec\theta = \frac{y}{5}$ first, generally managed to combine them with $1 + \tan 2\theta = \sec 2\theta$. Errors in the simplification of this meant that many of these did not get full marks, though this route was generally the most successful of the method used.
It was common to see solutions squaring x giving $(1+\sqrt{3}\tan\theta)^2 = 1+3\tan 2\theta$ before eliminating the parameter. A few solutions using $x = (1+\sqrt{3}\tan\theta)^2$ did manage to follow through the algebra correctly. Some students based their solution on a drawing of a right-angled triangle showing sides of $(x - 1)$ and $\sqrt{3}$ or with hypotenuse y and side 5. In the former, calculation of the hypotenuse left an easy route to a correct answer for y, but the latter was less successfully used.
The majority of those students who did manage to reach the final answer were aware of the need to put the final answer into surd form, though a few students did all the necessary hard work but left the value of k as $\frac{5}{\sqrt{3}}$ rather than $\frac{5\sqrt{3}}{3}$.

Question 14

This question proved to be a serious challenge for most students. It was surprising how few students used a diagram, especially useful in parts (a) and (b). Consequently the mean mark in this question was 4.9 out of 11
(a) Only half the students achieved the correct position vector d. There were many muddled or confused attempts. The task was to perform a – b + c, but there were many different ways to get there. A few students found the intersection of two lines at D, however this involved more work and gave greater scope for errors. Some students found the mid-point of the parallelogram and used this to find d.
(b) This was perhaps the best performed part of the question, perhaps due to its familiarity. Most students knew how to use the dot product formula for finding an angle and had a good understanding of how to apply it. Perhaps the most challenging aspect was choosing the correct two vectors to use. The other potential pitfall was in understanding how to gain the interior angle of the parallelogram rather than the exterior, which required using vectors BA and BC, rather than AB and BC. Others, having achieved an obtuse angle, went on to subtract from 180 in order to have an acute answer but failed to attempt to justify their actions.
(c) Most students knew how to find the area of the parallelogram using $|AB||BC|\sin\Theta$ but a common error was to find the area of the triangle leading to half of the required area. Where surds were used the answer was usually correct but many students lost accuracy as they used rounded decimal values from part (b). A few students just multiplied lengths of adjacent sides as though it were a rectangle.
(d) This part of the question required the student to multiply their answer to (c) by 1.5. Only a minority spotted this and various lengthy methods were also used to find the area of the trapezium most of which were unsuccessful. Some students misunderstood the question and thought that E was the midpoint of CD and so attempted to find the wrong area.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

http://qualifications.pearson.com/en/support/support-topics/results-certification/grade-boundaries.html