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Examiners' Report

January 2015

Pearson Edexcel International Advanced Level in Core Mathematics C34 (WMA02/01)

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General

This paper was the third Core 34 paper from the new 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 the most able students. Most students were able to apply their knowledge on questions 1,2, 3 5, 8, 10, 11, 12 and 13a. Timing did not seem to be too much of a problem as most students seemed to finish the paper. Questions 4, 6, 7, 8c, 9 and 13bcd 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 involving proof. This was evident in questions 7a, 9a and 10a. 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

This was an accessible question for virtually all candidates and many were able to score full marks.

Finding the value of y at x=3 was almost always attempted, usually correctly. Nearly all candidates knew how to differentiate to find the gradient of the tangent. The majority used the Quotient Rule for this. Of these, most used the rule correctly but there were some errors, particularly on the denominator. Other errors seen in the quotient rule involved poor bracketing, or more frequently from unnecessarily simplifying their expression for dy/dx. Those students who used the original unsimplified version of the derivative fared much better.

Other methods seen for differentiation involved the Product Rule, a method involving partial fractions or implicit differentiation. The value of the tangent gradient was nearly always found by correctly substituting x=3. A few then used this to form an equation of the tangent instead of the normal. Of those who did try to find the correct gradient for the normal, some then inverted but failed to take the negative value. However, the majority of candidates used the correct method for differentiation and for finding the equation of a normal and went on to score five or six marks on this question.

Question 2
This question was well attempted with many fully correct solutions seen. Cos2θ=1-2sin^{2}θ was well known and used, with only a few candidates using cos^{2}θ-sin^{2}θ first. Of these most went on to use cos^{2}θ+sin^{2}θ=1to reach a three term quadratic in sinθ. Occasional slips in using or quoting the quadratic formula were seen but for those who had the correct quadratic equation factorisation was usually recognised as the best option.

Solving sin x = ¼ caused little problem although not all candidates found the second solution in the range. Nearly all gave their answers to the required degree of accuracy. Of those who failed to do so, some gave 2dp instead of 3 dp and others had an answer of 2.89 with both answers being given correct to 3 significant figures rather than 3 decimal places. A few had further solutions within the range as a result of selecting incorrect quadrants. The majority of candidates worked confidently in radians.

Question 3
Part (a), this part of the question was tackled by all candidates, but very few were awarded the full three marks. The common mark profile for this question was 011 because the majority of candidates did not 'notice' the domain x ≥ 0 and the y-axis was invariably 'crossed' at (0, 8) extending the LH line segment into the 2nd quadrant, when it should have started at (0, 8). The V shape was the usual graph with most having the minimum point at (4,0).

In part (b), majority of candidates were able to obtain both solutions x = 1 and x = 13, the latter found by an equation of the type x + 5 = -8 + 2x. A much smaller proportion of candidates squared sides, the solutions then being the roots of the resulting quadratic equation. There was a small proportion who just found one value for x, usually x = 1.

Part (c) was well answered, especially if they found g(5) = 2, then f(2) = -1. However there were quite a few candidates who did not consider the modulus sign in the function g(x) evaluating g(5) = -2 the f(-2) = 11. Those who chose to substitute x = 5 into a gf(x) equation had less success, again not taking into account the modulus sign in g(x).

In part (d), many candidates struggled with finding the range of f(x). The maximum value of 5 was often not found at all. A good number who did find 5 as the maximum from f(4) often erroneously found 1 as the minimum from f(0). To find the minimum point, completing the square proved rather more popular than using calculus, but a large majority of candidates were able to obtain the correct minimum point and a smaller minority solved the quadratic to find the roots, then found the mid-point as x = $\frac{3}{2}$, followed by y = $-\frac{5}{4}$. The range of f was described in a variety of formats, the most succinct, $-\frac{5}{4} \le \mathrm{f}(x) \le 5$ being fairly frequently encountered along with $\left[-\frac{5}{4}\ ,\ 5\right]$

Question 4

This question, which has appeared in various guises within C4 papers, was not answered particularly well by candidates on this occasion and only a relatively small proportion of fully correct solutions were seen. The majority of candidates could achieve $\frac{dx}{d\theta} = 2\cos\theta$, and also substitute, $dx = 2\cos\theta\ d\theta$ and $x = 2\sin\theta$ into the integral correctly. Unfortunately that was as far as most candidates reached, as they failed to realise that $4 - (2\sin\theta)^2$ was identical to $4\cos^2\theta$, and as a result they failed to simplify their integral to $\frac{1}{4}\sec^2\theta$. For those who were able to reduce the expression to $k\sec^2\theta$, integration to $k\tan\theta$, substitution of limits and final answer proceeded accordingly.

Question 5

In part (a), the majority of candidates were successful in using the binomial expansion with n = -½ and x = -2*x* to obtain the quadratic expansion; it was rare for a candidate to just write it down without some working. Most followed on to multiply their 'quadratic' binomial expansion by (2+3x). The common errors seen were a lack of bracketing e.g. no brackets round 2+3x or using $-2x^2$ instead of $(-2x)^2$ although the correct answer was usually obtained. It must be noted that this was a show that questions and all aspects needed to be correct for the award of 4 marks.

(b) This was found to be very demanding for candidates. Many candidates just substituted $x = \frac{1}{20}$ into just one side of the given expression. It was clear that some candidates thought that $\sqrt{10}$ = RHS without any rearrangement and so ignored the LHS completely. Of the candidates who successfully solved the problem, the most common fraction was 1359/430.

Question 6

Overall candidates seemed to be either able to do part (i) or part (ii). Candidates who could do both parts successfully were in a minority and it was not unusual to see full marks in one part and only 1 mark in the other. Part (ii) proved to be the more accessible overall.

(i) Those who did attempt part (i) were often able to differentiate successfully with use of the Chain Rule as the most popular option. A few split *x* =tan4*y* x tan4*y* and some used implicit differentiation, usually successfully. Other attempts to rewrite the function before differentiation included the use of $x=\sin^2 4y/\cos^2 4y$ or $\sqrt{x} = \tan 4y$. These tended to be less successful. The majority of candidates who found dx/dy knew that the reciprocal was needed for dy/dx. Some stopped at this stage without converting to a function of *x* and for those who did use the identity $1+\tan^2 4y=\sec^2 4y$ and attempt substitution, a few mistakenly put tan4y=x thus failing to achieve the correct answer.

(ii) Presentation of the solution in part (ii) caused some issues. Most identified dV/dt = 2 and $dV/dx = 3x^2$ (with a number never explicitly stating this fact) and the majority were able to apply the chain rule correctly. Most candidates realised that they needed to use the Chain Rule but for some identifying the correct terms proved problematic. A surprising number of candidates were confused about the formula for the volume of a cube!

Question 7

(a) This part was well answered by the majority of candidates, who knew and were able to apply the compound angle formulae. The majority of candidates wrote down a correct expansion of both sides of the equation. A small number forgot about the factor of 2 at this point. Some candidates divided by cos x cos 30, and worked with an equation in tan x and tan 30 but the vast majority substituted for sin 30 and cos 30 prior to simplifying. Treatment of sin 30 and cos 30 was very good and, likewise, candidates working with tan 30 almost always used the correct value. Proceeding to an intermediate step with either tan x =(…)/(…) or sinx/cosx= (…)/(…) proved more difficult and of those reaching a correct equation for tan x, many failed to get the final mark as a result of failing to show any rationalising of their surd expression for tan x. Candidates should be reminded that for a 'show that' question each step of the method must be shown and in this question, which clearly stated ‘without the use of a calculator’, that included the rationalisation of the denominator.

(b) In part (b) the attempts were split evenly in three groups: those who had no meaningful attempt, those who spotted the need to solve $\tan(2\theta + 10) = 3\sqrt{3}-4$, and those who started again by expanding both sides and collecting up terms.
Using $\tan(2\theta + 10) = 3\sqrt{3}-4$ was by far the most successful method.

Candidates sometimes had problems replacing the LHS with $\tan(2\theta +10)$ with quite a few solving the equation $\tan 2\theta = 3\sqrt{3} – 4$ instead. Those using the ‘start again’ method had mixed success, with errors often appearing in re-arranging to make $\tan 2\theta$ the subject. Many worked with decimals and some lost accuracy this way. Some candidates failed to give answers to the correct degree of accuracy.

Question 8

(a) It was rare to see both marks achieved for part (a). Candidates tended to either find only one boundary or lost marks with inequality signs which were often the wrong way round or, in the case of the lower boundary, included the ‘equals’ as well as ‘less than’.

(b) The derivative of the given function was generally tackled well with occasional slips in signs and in arithmetic. It was pleasingly rare to see an extra factor of t when differentiating the exponential function. A few candidates had an extra incorrect term of 1000 in their derivative. A significant number failed to differentiate and used the original expression. Substitution of t=10 was virtually always carried out.

(c) Part (c) was a discriminating part of the paper with relatively few correct attempts. However, for those who did know what to do it was rare that errors were made, save perhaps giving a decimal answer. Those who realised that the method involved solving a quadratic equation generally got all 4 marks with those who didn’t scoring zero. The most common mistake was to take the ln of each term. Of those who recognised the equation as a quadratic the rest was nearly always done correctly. It was often solved by use of a calculator.

Question 9

(a) This was another ‘Show that’ question, and once again sloppy notation, or lack of working was costly. The majority of candidates correctly wrote that $\frac{dx}{dt} = \frac{1}{t+2}$ but quite a few then failed to write down the formula for the area under the curve $\int y \, \mathrm{d}x$ or $\int y \frac{dx}{dt} \, dt$ they just wrote down the answer given in the question. The most common careless error was missing out “dt” on one or more lines of the proof.

(b) A pleasingly large proportion of candidates knew how to deconstruct the given expression from (a) into partial fractions (though many did not). Of those that did the correct repeated factor form was usually seen and correct values for A, B and C obtained in the majority of cases. This was followed in the main by the correct integral. A minority split into just 2 partial fractions and then usually gained the 3 marks available. A common integration error was $\int \frac{2}{t^2} \, dt = 2\ln\,(t^2)$. The log laws were used correctly in the main to simplify the value.

(c) Very well answered, particularly for those who went directly for $t = e^x - 2$ substituting into y. A few then went on to expand the squared term. A few candidates attempted to rearrange $y = \frac{4}{t^2}$ to get t = … and substitute into $x = \ln(t + 2)$ and then rearranged this to get y = function of t. These candidates were less successful.

Question 10

This question proved to be a valuable source of marks for many candidates.

(a). Many candidates were confused by the presence of the factor of one third and thought that it was necessary to use the quotient rule with 3 as the denominator, which led to some derivatives having an extra term. In order to ‘lose’ the denominator some candidates decided to multiply the right hand side by 3 but failed to change the left hand side to 3y. The differentiation of the product was generally well done. Most candidates realised that they should equate the result to zero for a turning point but the rearrangement to obtain the required equation was often less than clear. Again, when an answer is given students must be very thorough and show all of their working.

(b) Many candidates scored all three marks on this part of the question. Of those who failed to do so, most obtained the first two answers correctly (2.273 and 2.271) but as a result of premature rounding gave the third iteration as 2.272. Candidates would be well advised to show a step of substitution rather than just writing down the answers from their calculator as this would enable them to gain a method mark even if their numerical answers were inaccurate.

c) Most candidates scored the method mark here, but a significant proportion failed to score both marks. The reasons for this varied. Having a correct value of 2.3 for *x* but failing to find *y* was common, possibly candidates need reminding that if coordinates are requested, then an *x* and *y* value (preferably paired in brackets) are required. A second reason is that candidates did find the *y* value, but failed to round sufficiently, giving (2.723,0.868) as an answer. Those candidates who had incorrect values in (b) did often attempt to find a *y* value and thus gain the method mark.

Question 11

(a) The vast majority of candidates who realised that the scalar product of the direction vectors was required obtained full marks in this part. There were many lengthy attempts at finding the scalar product of rearranged equations of the lines. It was common to see that candidates knew that the scalar product = 0 was relevant. A number also began this part by doing work toward finding values of λ and μ by equating y and z co-ordinates.

Part (b) was very well answered. The values for λ and μ were generally found well from the y and z equations, and *p* followed from the *x* equation. It was surprising that those who made a slip, leading them to awkward rational values for λ and μ, went on to use them, rather than look to see if they had made a small mistake usually arithmetical or sign errors in solving the equations.

(c) If (b) had been completed successfully candidates went on to answer this part successfully. Answers were often just written down.

(d) It is disappointing to see that the majority of candidates did not draw a diagram to answer this question. The common method was the use of $\overrightarrow{OB} = \overrightarrow{OX} + \overrightarrow{AX}$leading to one correct position for B. Another method for using x as the midpoint of A and B again only lead to one correct position for B. Other methods involving finding the vector $\overrightarrow{AX}$ and adding/subtracting multiples of $\overrightarrow{AX}$ to $\overrightarrow{OX}$ or $\overrightarrow{OA}$ were seen. Candidates who used $|\overrightarrow{AB}| = 2\,|\overrightarrow{AX}|$ leading to solving a quadratic equation in λ was also seen often with frequent success though some stopped on reaching a quadratic with large coefficients, and some having found 2 values of λ stopped before substituting these into the equation of the line 1, therefore did not achieve any marks for a lot of work.

Question 12

Part (a) was almost invariably correct but there were a few instances of 0.9241 or 0.924.

Part (b) was very well answered, only occasionally using incorrect values of h such as 2, 4, ¼, 2/5 (usually by incorrectly using the formula given). Candidates generally gained the M mark for the correct form of the Trapezium Rule. There were very few instances of including 2 & 1.2958 twice or missing values or the outer bracketing missing were seen. The main source of error was from their use of the calculator.

(c) Most candidates recognised that they had to apply 'integration by parts' on the first term, and often successfully, although the multiple of $\frac{1}{3}$ did interfere with the progress of many. The correct answer was often found though some did not heed the requirement for the form of the answer to be in the form a + lnb leaving 3ln3 as part of the answer. Not all candidates recognised the correct method and some tried to integrate x^2 and ln(x) and then multiply their products, others used 'by parts' the wrong way round or with an incorrect formula. It was not uncommon for only the B mark to be scored for integrating -2x + 4.

(d) This part was answered well if candidates had achieved an answer to (c), though too many made the mistake of dividing by the approximation from (b), rather than the exact answer found in (c).

(e) Most candidates had the right idea about increasing the number of strips and managed to communicate this. A common incorrect answer was increasing the number of decimal places. Those who mentioned the area being an under or overestimate must have misunderstood the question.

Question 13

This question proved to be an effective discriminator.

(a) This was by far the best attempted of the four parts and was well answered by the majority of candidates. Lost marks were generally due to inaccuracy in giving the value of α or for giving R as a decimal rather than √109. Occasional candidates had their value of tanα as 10/3. In the rest of the question it was quite common to see cos(30*t* – α) even where it had been found correctly in (a).

(b) Only the more able candidates succeeded on this part. Many candidates failed to realise that the maximum value of H occurred at the minimum value of the cosine function, so that answers of 12 - R were common in part (i) and likewise setting

(30t + α) equal to 0 or 360 in part (ii). Having (30t - α) rather than (30t + α) was another common reason for losing marks.

(c) A healthy proportion of candidates scored full marks on this part. Most candidates set H=18 but some did not use part (a) to proceed and these candidates were unable to gain any marks. It was very common to see a sign slip leading to cos(30t + 16.7) = 6/√109. Those who did not make this slip were generally successful in following the correct order of operations, choosing the second quadrant for the angle and finding t to 2dp although occasionally premature rounding cost a candidate the final mark.

(d) Very few candidates were successful on this part. Of those who attempted it most multiplied their time from either part (b) or part (c) by 4.

Grade Boundaries

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