Examiners' Report

Principal Examiner Feedback

January 2017

Pearson Edexcel International A Level
In Core Mathematics C12 (WMA01)

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January 2017
Publications Code WMA01_01_1701_ER

General

Students found this paper accessible although it was not clear whether the number of blank responses to Q12 and the final question was indicative of students running out of time. The quality of many responses seen was high, showing that students had been well prepared by their teachers. Q5, Q8(d), Q9(b), Q14, and Q15 were found to be the most challenging on the paper. Overall the level of algebra was pleasing, although a lack of bracketing was apparent in some cases. Some students are clearly relying heavily on their use of calculators, as correct answers to quadratic equations in surd form and answers to definite integrals appear too often with no working. Errors were common throughout when dealing with negative or fractional powers – both with calculus and with solving equations involving them. A point that could be addressed in future exams is the lack of explanation given by some students in making their methods clear. Students need to be aware that when asked to produce, or prove, a given result they must be careful to include all the necessary steps, and to check that they have not made a slip in presenting the final result.

Question 1

(a) This was generally answered very well with the majority of students able to score 2 or all 3 marks. There were occasional errors involving not bringing the power down to cancel out with the 1/3. Very occasionally students multiplied by 3 before differentiating, and then failed to divide by 3 afterwards, thus losing 2 marks, although they could go on to recover and gain full marks in (b).

(b) Most found the 2 critical values correctly and many also chose the outside region required. However, a significant number did not give a set of values, stopping at $x = 1$, $x = 3$, or chose the wrong region. Common answers, losing the final two marks, were $1 < x < 3$ and $x > 1$, $x > 3$, and many lost the final mark for solutions given in the form $x > 3$ and $x < 1$, and $1 > x > 3$. The use of set notation was seen relatively rarely, but when used was usually correct.

Question 2

The majority of students scored well on this question.

In (a), most students attempted to complete squares to rewrite the equation. Some sign errors were made within the brackets with consequential errors in the coordinates of the centre. Rearrangements such as $x(x-8) + y(y+4) = 12$ also led to incorrectly stated centre coordinates such as (-8, 4). Also some students produced perfect revised equations but then failed to identify the coordinates of the centre.

In part (b), those who did not score full marks sometimes mislaid the '12' or failed to differentiate between r and r^2.

In part (c) some students substituted $y = 0$ instead of $x = 0$, usually resulting in one mark out of three. Those who correctly used $y = 0$ were largely successful in reaching the required 3 term quadratic, but quite a few could not deal with the manipulation and sometimes ended up with incorrect signs, $y = -2, 6$. A surprising number of students did unnecessary extra work by also finding the intercepts on the x-axis and combining the two sets of results.

Question 3

This was generally a well answered question with a significant majority able to score full marks, although many students lost accuracy marks for incorrect rounding in parts (b) and (c). Many also lost marks by mixing degrees and radians, either 90 - 0.8 in (b), or using degrees in the cosine rule when their calculator was in radian mode or vice versa. Overall, careless errors were very common.

(a) For most students this was two accessible marks, using the correct formula, $r\theta$, with θ in radians, although sometimes time and accuracy was lost by students preferring to work with degrees.

(b) This part was again answered well, although too many students either worked in degrees and left their answer in degrees or attempted to change to radians and lost the accuracy mark; 0.770 was a common answer. In finding angle POC some students thought triangle COP was a 3, 4, 5 triangle which resulted in no marks in this part, and some did not appear to know the number of radians in a straight line or a right angle; both of these errors proved costly in (c).

(c) Most students were able to get a method mark for the correct use of the cosine rule to find CP or CP^2, although students who had either (a) or (b) wrong were unable to gain full marks. The word “perimeter” was a problem for some students: a few calculated the area of the three shapes, and a significant minority thought that they needed to add every length in the figure.

Question 4

(a) Most students were successful with this part. The arithmetic series sum formula was almost always used correctly. Few slips were seen with completion to the given answer. A small number of students chose to express the sum as a list of all the terms.

(b) Some students were unable to produce a second equation in a and d, with some very confused responses and some poor algebra being seen. Common errors were to equate the 7th term to half the 8th term, or the 9th term to half the 8th term, or the sum of 8 terms to half the sum of 7 terms. Other errors were seen, such as equating the expression for either the 7th or 8th term to zero. Those who obtained the correct equation were usually able to solve simultaneously with the given equation from (a) to obtain the correct a and d values.

Question 5

For those students with a good understanding of log laws this was a straightforward question, and those with a correct expression for (a) usually went on to score most, if not all, of the marks. However, this was badly answered by many students.

(a)(i) Many students gained the method mark, usually for reaching $y - \log_3 9$; however it was often left in this form and so did not gain the accuracy mark. Clearly some students were confused and started by writing "$y = \log_3(x/9)$", and others thought they had to solve $y - \log_3 9 = 0$, and so $y = 2$ was seen.

Occasionally the double error $\log_3(x/9) = \log_3 x / \log_3 9 = y - 2$ was seen, which gained no marks.

(a)(ii) A common error was, having written $\log_3\sqrt{x} = \log_3 x^{1/2}$, to give the answer $y^{½}$.

(b) Most students who were successful in (a) were able to answer this part quite easily by using their answers to create a linear equation in y, although some chose to write $2\log_3(x/9)$ as $\log_3(x/9)^2$ which unfortunately became $(y - 2)^2$, resulting in no marks being gained. Of those who successfully reached the stage $2(y - 2) - y/2 = 2$, the accuracy marks were frequently lost for algebraic slips such as $2y - 2 - y/2 = 2$. Many lost the last two marks by only solving for y and failing to find a value for x.

However, many students did not use their results from (a), which often was very fortunate, and started from scratch using the log rules and solving an equation in x. The vast majority of such students used the method outlined in Alt 1 in the mark scheme, although many students lost the final mark as they were unable to correctly process the indices in the final equation. There were a couple of elegant solutions found by separating out the division, multiplying out the brackets and collecting like terms to get $(3/2)\log_3 x = 6$.

Question 6

(a) (i) Most students attempted to rearrange the equation of l_1 to make y the subject, and so wrote down the correct gradient, but in their subsequent working some used the equation as $y = 3/2\ x + 5$.

(a) (ii) Most students knew that they had to use $y = 0$ in the equation of l_1 and find the value of x, with most answers being correct. An occasional wrong answer was $x = 5/3$.

(b) Most students used the correct rule for finding the gradient of the perpendicular from what they thought was the gradient of l_1 although some wrote down the negative reciprocal of the x coordinate found in (a). Most realised that the y coordinate of point B had to be determined, though some clearly had not appreciated that the x coordinate of B had been given in the question. Students who marked coordinates on the diagram usually scored good marks in this question. Sometimes the equation of the line was not given in the required form. The alternative method of equating the two lines without finding B was seen very occasionally, but usually successfully.

(c) Correct answers were not common, although the first mark for an attempt at the x coordinate of C was widely scored. Of the students who were successful, most found the area using

$\frac{1}{2}(AC)(y$-coordinate of $B)$, or the equivalent using two triangles.

Attempts using $\frac{1}{2}(AB)(BC)$ were more prone to mistakes using Pythagoras, although there were a pleasing number of correct attempts using this method. Some students used values for the coordinates of the vertices that clearly could not be possible from the diagram, such as a negative x coordinate for C.
Most students worked with exact values, including surds where necessary, and so gave an exact answer. Only a few worked with decimals and so could not gain the final mark.

Question 7

(i) Success in this part was dependent on gaining the first method mark for attempting to split up the given algebraic fraction before integrating. Most students who gained this mark often went on to gain at least 3 of the 4 marks, with many students gaining full marks. Even careless algebra, such as $(2 + 4x^3)x^{-2} = 2x^{-2} + 4x^{-6}$ or $2 + 4x^3x^{-2}$(omission of brackets) $= 2 + 4x$, and occasional slips in integrating, especially with the negative power, e.g. $2x^{-2}$ integrated to give $-\frac{2}{3}x^{-3}$, often meant that only the final mark was lost, as did the omission of "+ c" in the final answer.

(ii) A substantial number of students managed this part correctly, but many lost the final mark for giving a decimal answer instead of an exact expression asked for. There were, however, several common errors seen: $4/\sqrt{x}$ incorrectly written in index form before integrating; $4x^{-1/2}$ incorrectly integrated; k integrated as $\frac{1}{2}k^2$ or left as k, which resulted in the loss of at least 3 of the 5 marks; a sign error on the lower limit for kx leading to $6k$ rather than $2k$ in the expression equated to 30. Most students could substitute $x = 4$ and $x = 2$ correctly, subtract and set equal to 30 although some chose to work with each substitution separately and erroneously set both equal to 30. The small number of students who just substituted into the integrand gained no marks.

Question 8

Many students scored well on this question although it was disappointing to see how few managed full marks.
(a) Evaluating f(3) almost invariably produced the correct answer. Long division (in a variety of formats) was significantly less successful.
(b) This was very disappointing. Whether tackling this by evaluating f(-2) or by long division, the desired value of 0 was usually reached. Many students, however, failed to give a conclusion of any sort.
(c) This was well done by the vast majority of students with errors in the 3 term quadratic rarely seen, followed by, usually correct, full factorisation. Just a few students seemed to resort to using a calculator to obtain the roots of the cubic and then attempting to produce the product of three factors.
(d) This part was completed successfully by fewer than half the students. Many omitted it, others substituted $3t$ or 3^{3t} in error and others performed dubious logarithmic working. However most students who got that far correctly rejected the possibility of 3^t being negative.

Question 9

(a) A significant number of students scored full marks in this part, with correct differentiation and then a correct solution of the equation $-8x^{-2} + ½ = 0$, formed by equating the gradient to zero, although occasionally the corresponding y coordinate was not found. However, a few students found the solution difficult as they were unable to deal with the negative power, some attempted to solve $d^2y/dx^2 = 0$ instead of $dy/dx = 0$, and occasionally the equation

$x^2 = -16$ was formed with $x = \pm 4$ usually given as solutions. Despite the instruction in the question to use calculus, incorrect methods were seen, such as assuming that the x co-ordinate of A was half-way between 0 and 8; such methods scored no marks.

(b) On the whole students correctly identified the effect of the transformations involved but often lost marks because they seemed not to understand what was meant by the roots of an equation; it was common to see the co-ordinates of all three key points each time.

Although each part was only worth one mark, suggesting that little working would be required, a significant minority of students set up and solved, usually correctly, new equations in x.

In (i), since only values of x were needed, stating full coordinates did not gain the mark; a majority of students were penalised on this account.

In (ii), follow through was allowed from part (a). As the question asked for the coordinates of the turning point it was less common to see extra points, and this mark was often gained.

In (iii), some leniency was allowed with the idea of transforming the points to get the answers, so that (½, 0) and (2, 0) did gain the mark, and adding an attempt at the transformed turning point was ignored. With this degree of leniency this mark was often gained.

Question 10

Overall, this question was very well answered with working usually well set out.

In part (a), a few students used the binomial theorem to expand the given expression and then did not equate coefficients, scoring no marks. A few students chose incorrect expressions for the coefficients when equating. Very occasionally there was a mismatch between the binomial coefficient and the power of x.

Common errors in part (b) included $a = 5$ (from dividing 20 by 4) and $p = 38$ (from only multiplying by a single power of $a = 1/5$).

In part (c) the answer $q = 969$ was sometimes given, again from only multiplying by a single power of $a = 1/5$. Some students lost the accuracy mark by giving $q = 7.75$.

There were few instances of powers of x being wrongly included in the answers for values of the constants.

Question 11

Few students scored full marks on part (i), mainly due to lack of accuracy with their answers (e.g. 3.99, 4 and 5.42, the latter though rounding the principal value to 0.86) or by not finding all solutions. The majority found at least two solutions.

Some students had problems with making an appropriate substitution for $\cos^2 x$ or $\sin^2 x$ and/or rearranging to obtain $\cos^2 x$ or $\sin^2 x = \ldots$
There were also incorrect attempts at solving $\cos^2 x$ or $\sin^2 x = \ldots$ with the square root sometimes being forgotten. Few students failed to give their answers in radians (although many found the answers in degrees first and then converted).
There were many fully correct answers for part (ii), although few students had success with the alternative methods in the mark scheme. Common incorrect rearrangements of the equation included tan (…) = 5 and tan (…) = 0. Just a few started by incorrectly writing $\sin(\theta + 10)$ as $\sin\theta + \sin 10$.

Some students substituted another letter for $(\theta + 10)$ but then forgot to reverse the substitution, thus losing the second method and associated accuracy marks. Some students mixed degrees and radians, presumably through not switching their calculators to degrees after attempting part (i).

Occasionally no attempt was made at this question.

Question 12

Quite a number of students made no attempt at this question. Those that did attempt it often scored highly in (a) but solutions to (b) were variable, with some excellent, fully correct solutions but also many that only gained a maximum of 3 marks. Some students were penalised because they did not heed the instruction that use of calculus was required.

(a)There was a large number of students who scored full marks. However there were some who did not use calculus to find the gradient of the line; they scored no marks. For example, using the given equation of the line to find the coordinates of its intersection with the x-axis and then, with the coordinates of A, showing that the gradient of the line was 5. The main causes of loss of marks for those who used calculus were: for a small number, integrating rather than finding $\mathrm{d}y/\mathrm{d}x$, which had a maximum of 2 method marks; finding the equation of the normal, rather than the tangent, which usually gained 3 marks; having a correct expression for $\mathrm{d}y/\mathrm{d}x$ but not clearly showing how the gradient was 5, which usually lost the final mark, or in a few cases solving $\mathrm{d}y/\mathrm{d}x = 0$.

(b) The majority of students used "Way 1" from the mark scheme, integrating the curve between 1 and 4 to obtain 217/12 or 18.08 and then subtracting the area of the triangle with vertices at (1.8,0) (4,0) and (4,11). This was the most successful of the methods, though it was quite common for students to stop after the integration, just gaining the first 2 marks. A common error in calculating the area of the triangle was to use ½x4x11 instead of ½x(4-1.8)x11, and rounding the area under the curve between 1 and 4 to 18.1 resulted in the loss of the final accuracy mark.

A small number of students found the area of the trapezium whose vertices were (1, 3.75), (1, 0), (4, 0) and (4, 11), but very little constructive work followed.

Other students used "Way 2", integrating the curve between 1 and 1.8 then adding the area between the curve and the line from 1.8 and 4. Students who attempted to integrate any combination of "curve – line" often had more difficulties successfully completing the integration and frequently used the wrong limits.

The least successful of the methods in the scheme was "Way 3", which involved finding the area between the curve and the line between 1 and 4 and then subtracting the triangle below the x-axis which had vertices at (1, 0) (1.8, 0) (1, - 4). It was quite common to see the solution stop after finding the area between the curve and the line between 1 and 4, and this usually only gained the first two marks.

Question 13

(a) A surprising number of students seemed to be put off by the 'c' in the equations of both curves and resorted to choosing a value for c to plot points. Others made no attempt at all to sketch the curves and so gained no marks. The curve sketching skills of many were disappointing and too many students did not seem to know what curves to expect from the given equations and tried to fit a curve to their wrong intercepts, resulting often in non-smooth curves. Only about 15% of students scored full marks on the two graphs.

(i) Of those who did attempt this sketch, most were able to give the correct shape of the negative quadratic $y = c^2 - x^2$, although lack of symmetry in the y-axis and errors in the intercepts were quite common. It was disappointing, however, to see the number of wrong shapes usually a "U" shaped parabola, but others included straight line graphs through $(c, 0)$ and $(0, c^2)$.

(ii) Many students were able to sketch the shape of a positive cubic but a significant number of these were unable to relate the equation to the intercepts on the x-axis, in particular the location of the double root, which was often seen at $(3c, 0)$, or even $(-3c, 0)$. Significant numbers of students also lost marks for careless errors when sketching i.e. branches that turned back in on themselves, a pointed maximum and allowing the cubic to tend towards an additional maximum/minimum. Those students who sketched a negative cubic were often able to score the second B mark.

(b) This part was generally well done with the majority of students correctly equating the equations and attempting to expand. However many students lost the accuracy mark due to a sign error or other careless slips when rearranging the equation. Some also lost the mark as there was not enough working before reaching the final answer or by failing to give the final answer in the required form.

(c) This part was generally answered well, with most students able to get at least the two method marks. The most common mistakes here were algebraic, with a significant number of students not able to obtain the correct three term quadratic, although attempts at solving their 3 term quadratic were generally good. For those who used their calculators to solve their quadratic, so showing no working, they only gained the final two marks if they gave the correct exact answer. Many students lost the final mark for not discarding the negative solution.

Question 14

For the proof of the geometric series formula in part (a) most students seemed to score either no marks or full marks. Many began by writing an expression for S_n and then repeating the sum but with the terms in reverse order, as though they were trying to prove the formula for the sum of an arithmetic series. This inevitably led to no marks being gained.

A few students missed out the first or last terms of one of their expressions for S_n or rS_n and some lost the final mark because they did not write + signs between the terms in their series. Many students just left this part out.

In part (b) the majority of students were able to score both marks, but a few used 0.07 instead of 0.93 and so were unsuccessful here (and usually also in part (c)). Some expressed their ratio as 93% or 1 - 7%.

The vast majority of those who attempted part (c) failed to fully understand the question but were able to achieve the first mark for attempting the sum of a geometric series with $r = 0.93$ and allowable values of a and n.

Those who did manage to achieve the first two marks here generally went on to achieve the third although there were a few students who did not round to 1831.

There were a few attempts at listing the terms, some successful but others with rounding errors or missing terms.

Question 15

Many students did not attempt this question and only a small proportion of those that did managed full marks. Students needed to form a strategy for finding the area of R to give in the form kr^2, where k is exact. There were several strategies for finding this area, the most common being to add the area of triangle LMN to the area of the three segments surrounding it. The most succinct method was to find an expression for area of 3 sectors and subtract twice the area of triangle LMN, which gave the required result almost immediately. Many responses indicated the knowledge of the formula for the areas of a segment, sector and triangle, although the area of a sector was very commonly given as ½ r^2 x 60 or $30r^2$, using degrees instead of radians. The expression for the area of triangle LMN was more often correct using ½ $ab \sin C$, although surprisingly some students struggled, using ½ r^2 or in trying to use the formula ½ base x height with the wrong height from incorrect use of Pythagoras' Theorem. The value of k needed to be exact, so that students who used decimals throughout lost the two accuracy marks. The algebraic manipulation, with surds and π involved, proved beyond many students. Some students clearly had not registered the fact that triangle LMN was equilateral and unfortunately used θ throughout.

Grade Boundaries

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

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