Pearson

Examiner's Report
Principal Examiner Feedback

October 2018

Pearson Edexcel International A Level
In Core Mathematics C12 (WMA01/01)

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General Introduction

Students seemed to have been well prepared for this examination. Some excellent scripts were seen and there were fewer students who scored very low marks. It proved to be an accessible paper with a mean mark of 89 out of 125. Timing did not seem to be an issue either, with most students able to complete the paper. There continues to be an improvement in attempting "show that" questions.

Points that should be addressed by centres for future examinations are;

- care should be taken by students when copying their own work from one line to the next and that they have actually written down correctly, any answers that are printed on the question paper. 8(a) was an example where the second mark was lost unnecessarily.

- care should be taken by students with notation when appropriate. This was highlighted by responses to 12(a) where powers of 2 were incorrectly positioned with trigonometric functions and inconsistent variables were sometimes used.

Question 1

Part (i) was easy for most students. The majority chose to use indices and many went straight to $a = 3.5$. The most common error was to mishandle the left hand side. Some students used logs correctly but the most common error was in expressing $125\sqrt{5}$ as a power of 5 in order to use the power rule. Some students surprisingly thought that they needed to change the 125 into $\sqrt{125}$.

Part (ii) was well done on the whole, with the majority showing the correct use of the difference of two squares in order to rationalize the denominator and obtain 8. Just a few made errors in multiplying out the numerator.

Question 2

This was a straightforward question for which many students gained full marks. However, in others it showed up a weakness in basic algebra.

The majority of students attempted to rearrange the linear equation and substitute into the second equation but sign errors in the expansion of $(5-x)^2$ resulted in either an incorrect quadratic equation or to the loss of the x^2 term and therefore no quadratic equation to solve.

Too many students equated $(5-x)^2$ to $25+x^2$, leading to an incorrect quadratic equation. A few students thought that $x+y=5$ implied $x^2+y^2=25$, then subtracted the equations so as to eliminate the x^2 and y^2 terms.

A significant number of students found the correct values for one of the variables but forgot to find the other.

Question 3

This question was accessible to the majority of students and many gained full marks.
In part (a) the method mark was generous and achieved by almost all students. Most students earned the first A mark for their differentiation of $2x^3$ but then the final mark was sometimes lost due to a variety of errors (sign, coefficient or index). Some tried to write the expression for y with a common denominator and then just differentiated the numerator.

In part (b) a few students attempted to integrate their answer to part (a) rather the given y, earning no marks. Most, however, gained at least two marks for the correct, simplified integration of $2x^3$. Again, the incorrect manipulation of the second term often led to the loss of the final two marks. A few students failed to include an integration constant, losing the final mark.

Question 4

This question was generally very well answered by all students with the majority picking up full marks. Students mostly understood the notation and how to use it in both parts of this question.

In part (a), students were usually successful in forming the equation and solving to find the correct value for k. However, there were a number who made sign errors, commonly it involved $u_2 = 2k + 9$ and $u_4 = 4k + 81$. This error only resulted in the final mark being withheld.

In part (b), most students understood they needed to sum the first four terms together and correctly used their value of k to find the first 4 terms. This resulted in students scoring either 2 or full marks. There were some students who made arithmetical errors summing 4 correct terms. Those who had an incorrect k generally did not appreciate that u_2 and u_4 should have been equal, which should have prompted them go back and check their part (a) answer. There were a number of students who used the sum of an arithmetic series using their first and last terms and were unable to score any marks in this part.

Question 5

Part (a) was answered accurately by many students and all 4 marks were very accessible.

Most correctly paired the correct binomial coefficient with the correct power of x although a number struggled with the negative sign and wrote $1 + 5x + 45/4x^2 + 15x^3$,
or even $1 – 5x – 45/4x^2 – 15x^3$. A number of students also left their answer as
$1 + (–5x) – 45/4x^2 +(–15x^3)$.

There were some errors in the values of the third and fourth terms. These were mainly caused by either a failure to raise the –½ to the correct power, or evaluating ${}^{10}C_2 = 90$ and/or ${}^{10}C_3 =$ 720 or 240.

The responses to part (b) were more varied and it was clear that many did not understand the question, giving the answer of $-15(x^3)$, or substituting values into the expansion (eg $x = 0.1$), or only multiplying the contents of one bracket by one term of the other, usually $-15x^3(3 + 5x - 2x^2)$.

Only the strongest students realised three x^3 terms were required to be summed from the full expansion of the brackets. Even when these were identified, arithmetic slips and sign errors were fairly common. The $3(-15x^3)$ was the term most frequently omitted. Some correctly found $10x^3$, $225/4x^3$, and $-45x^3$ but did not combine them. A few substituted the coefficient of x^3 from part (a) into the expression given in part (b).

Question 6

In part (a) it was relatively rare to see both marks scored. Many students had an incorrect shape, with an increasing curve drawn instead of a decreasing one. The mark for the y-intercept was more commonly awarded. Some students did not attempt a sketch and others who were unaware of the shape, drew a rectangular hyperbola or sometimes a straight line. Students often had more success in part (b), although, not unusually, there were those who miscalculated h, often dividing by 5 instead of 4, and those whose lack of precision with brackets meant they didn't apply the trapezium rule correctly.

Question 7

Part (a) was almost always correct with a small number of students finding (change in x)/(change in y). Part (b) was well attempted but many unnecessarily lost the final mark for not giving integer coefficients. This was often as a consequence of students using -0.8 rather than -4/5 for the gradient. In part (c), the mark for a correct midpoint was almost always awarded although some students wrote the coordinates the wrong way round. The rest of part (c) caused problems for many students. Particular errors identified by examiners included the incorrect use of Pythagoras' Theorem, with coordinates added rather than subtracted and with confusion over which x and y coordinates to use. Of those who managed to navigate the algebra and deal with the square root, some did not consider the negative and positive root and so only ended up with one value for k. Others ignored the instruction to give exact answers and so lost the final mark for giving decimal answers.

Question 8

This question was attempted by most students, and almost all had at least some success and could score some of the marks. Most used the remainder theorem correctly in part (a) although again there was sometimes an unnecessary loss of a mark for careless copying errors from one line to the next. Some finished with p + q = 5, despite the correct equation being given in the question. Students who attempted (a) using long division were rarely able to achieve the correct answer.

In part (b), many students were successful, although there were often algebraic errors in the solving of the simultaneous equations. The most common of these was an ncorrect attempt at dividing both sides of -2p + q = 28 by 2, resulting in p + q = -14. Many then attempted to solve this along with p + q = -5, not noticing that p + q should not be equal to two different values. A few started with p + q = 5 as one of their equations.

In part (c), those students who had the correct values of p and q in part (b) often continued to achieve full marks. Those who had incorrect values often stopped when they saw their cubic equation was not divisible by (x + 2), gaining only 1 of the 4 marks in this section. Of those with the correct quadratic factor, most did attempt to factorise, usually correctly. Some used the quadratic formula to find roots only and lost the last 2 marks.

Question 9

This arithmetic series question was attempted by almost all students, and many achieved full marks. A small number of students used the formula for geometric series and achieved no marks.

In part (a), a simple algebra error was commonly seen, where students wrote n – 1 = 25 followed by n = 24, which then also lost accuracy marks in part (b).
In part (b) the common error was to treat the whole 50 weeks as one arithmetic series with 50 terms. Values students used for "a" and "d" varied considerably, but "a" was most often taken as 1000 or 1500.

Several responses were seen where the sum of the first 26 weeks was incorrectly considered to be 1500. A few responses were seen which listed all the terms, and often there were errors using this method.

Question 10

In part (a) most students recognized that they needed to solve simultaneous equations here and achieved the first mark. Many students did struggle to solve an equation involving $x^{1/2}$ and x. A sizeable number replaced the $x^{1/2}$ with x and x with x^2, without squaring the coefficients, resulting in an incorrect answer of $x = 3$. Others correctly achieved $x^{1/2} = 3$ but then incorrectly put $x = \sqrt{3}$. Virtually all students found the coordinates of D(0, 5) accurately. Part (b) caused many students to lose a mark. The most common mistake was to just state that when $x = 25$ $y = 0$, or to substitute $x = 25$ into the equation but fail to evaluate the $4(25^{1/2})$ term as 4(5) or 20. Students who solved the equation using quadratic methods were more successful and usually scored the mark, although these were longer methods. Some poor attempts to solve an equation were seen by factorising to eg $x^{1/2}(4 - x^{1/2}) = -5$, therefore $x^{1/2} = -5$, $x = 25$. Attempts at squaring the equation in order to solve it sometimes failed due to squaring each term rather than each side.

In part (c) the first 2 marks were awarded for correct integration and the virtually all of the students who attempted this question achieved this. It is worth pointing out that some students integrated $4x^{1/2}$ as $6x^{3/2}$ with no intermediate step, thus losing an accuracy mark. Students who wrote down $(4x^{3/2})/3/2 = 6x^{3/2}$ were able to score this mark for the correct unsimplified term.

The next 3 method marks were achieved by many of the students, including those who failed to get the correct values for coordinates for the point E. The most common approach was to find the area of the trapezium and the area bounded by the curve and x = "9" and $x = 25$. Almost all found one valid area, but a common error was to not find a valid pair of areas. A significant number of students integrated the curve between 25 and 0 and then were unsure of how to proceed, or thought they had a final answer. Way 3 on the mark scheme was very rarely seen. A few students achieved the correct value with no evidence of any algebraic integration and so lost marks as specified in the mark scheme.

Question 11

This question proved to be challenging for a large number of students. This was particularly due to poor setting out of solutions or careless use of notation.

Part (a) was started well by the vast majority of students. There was clear recognition of the need to use the discriminant and most rearranged the given equation to collect all the terms on one side to begin the process of identifying the coefficients 'a', 'b', and 'c'. The k^2 term was sometimes seen to be grouped with the x^2 term thus making "a" incorrect and "c" incorrect. Expanding $4ac$ produced sign errors for some. The inequality caused issues with some starting with < 0 as they looked at the final answer rather than appreciating the discriminant had to be greater than 0.

In part (b), students were very successful in solving the quadratic equation and so finding the critical values for the required region. However a sizeable number were unable to correctly identify the inside region and some who did, had errors with the inequality signs. Some students who did not manage to achieve the printed answer in (a) used their answer rather than the printed answer in (b). The most common range given was $-7/3 < k < 7/2$ and other notation was used infrequently. A surprising number of students used x rather than k in their final answer and some students stopped once they had found the critical values.

Question 12

Many students were successful with part (a), using the two required identities. Some lost the final mark due to the omission of a step of the proof or due to notational errors such as writing $\cos^2 x$ as $\cos x^2$ or writing tan x as (sin/cos)x.

In part (b) most students solved the given quadratic, achieving the value $\frac{2}{3}$ and gaining the first two marks. A significant proportion, however, did not attempt $\frac{1}{2}\left[\sin^{-1}\frac{2}{3} + 10\right]$, finding only '$x$' rather than θ. Others used the operators in the wrong order to find θ and gained no further marks. Some students gained the second M by achieving 25.9, the smallest value of θ, but then wrongly calculated 180 – 25.9 as the second value of θ. Apart from numerical slips it was common for two of the required solutions in the given range to be omitted.
Just a few failed to see the link between parts (a) and (b).

Question 13

Many students appeared to find this question difficult and it was common to see only one of the two parts attempted.

For part (i) there were various ways in which the power law of logarithms (or logarithm definitions) could be applied at some stage and many responses gained the first method mark but no more. A very basic error was to equate the indices $3x + 2 = 600$ which showed an ignorance not only of logarithms but also of indices. Another was to begin by stating $\log_4(3x+2) = \log_3 600$.

Some students calculated 3 as a power of 4 so that they could then equate the indices and this often gave the correct answer, but occasionally rounding errors led to loss of accuracy.
There were some neat and sophisticated responses which demonstrated a good understanding of the topic and most students gave their answer to the required 4 significant figures.

Part (ii) was generally found easier than part (i), but here an occasional error followed the omission of a bracket, giving $3x + 2\log 4$ instead of $(3x+2)\log 4$.

Most students knew the subtraction law of logarithms but some did not deal with the $2\log 5$ first and tried to apply the law incorrectly. Most were able to remove the logs correctly and there were only a few examples of the incorrect 4^a instead of a^4.

This question demonstrated the need to read the question carefully as a fairly common mistake was to give the answer as an expression for a in terms of b rather than b in terms of a as required.

<u>Question 14</u>

Many students did not attempt this question at all. Of those that did, a large number only attempted part (a).

In part (a) the centre was often found incorrectly by treating the constant k as a coefficient of an x term and giving the centre as (-k/2, -8). Many of these students could not proceed further.
Many also confused the positive and negative signs giving the centre as (0, 8).

Part (b) was often answered incorrectly. Some students took k = √10, or k = -10. Others used 10 and 64 and incorrectly obtained k = 54. Some had the correct method but made an algebraic error resulting in k = 164 instead of the correct value of k = -36. Many other incorrect methods were seen, including k = 100/64.

Of those who attempted part (c), a very common error was to take the "O" to mean the centre of the circle and not the origin. Some students made hard work of finding the value of the constant a, although the mark scheme was generous and allowed students to tackle the question in terms of the letter “a” for some of the method marks. There were a surprising number of careless mistakes when finding the radius gradient and there were a few instances where students attempted to find the required gradient using implicit differentiation but these were rarely successful. Of those who could make progress in finding the points D and E, many students adopted a correct approach for the area of the required triangle, although some used the wrong triangle or used Pythagoras Theorem to find inappropriate or unnecessary lengths.

Question 15

For part (a) most students appeared to understand the process required, i.e. to create an expression for the perimeter including the arc length, then to use the given area to create an equation which could be rearranged allowing substitution of y leading to the given answer. A few students confused the arc length and sector area formulae and a few used θr^2 rather than halving this. Algebraic manipulation caused most problems but those who simplified their rearranged equation in y normally faired better.

In part (b) the vast majority of students differentiated correctly and equated to zero. Some were defeated by the algebra in their attempts to find x. Having found x, however, a very significant number then failed to substitute back to find P, throwing away two relatively easy marks.

To confirm the minimum in part (c) most students found the second derivative, usually correctly, and managed either to substitute a positive value of x or to correctly explain that the second derivative had to be positive. Some attempts, however, failed to explain the sign of the derivative or failed to give the necessary conclusion. An occasional mistake was to substitute the value of P rather than x into the second derivative.

Question 16

Most students attempted this question, implying that the paper allowed students to access all the questions. Many scored the last 6 marks even after zero for part (a). There were a few who stopped after failing to get the required equation. Whether this was due to a time constraint or lack of awareness that they could continue was unclear.

In part (a) the responses seen by examiners in this part were extremely mixed. Many stated a correct equation for k e.g.$(2k – 24)/k = k/(k + 5)$ and then went on to correctly derive the given quadratic. Alternatively, some had been taught to use $ac = b^2$, where a, b, c are the terms in order. Others struggled with setting up a correct equation, some students simply expanded $(2k – 24)(k + 5)$ and then just changed the coefficient of x^2 from 2 to 1. Others multiplied all 3 terms together getting a cubic, or used the discriminant $b^2 – 4ac$ to form a relationship. A large number of these students simply altered their equations to the printed form with no mathematical reasoning. For those that did have a correct equation, some had errors either with expanding or poor use of brackets. A few attempted to apply the fact that $ar^2 = 2k – 24$, then multiplying out to a cubic expression, these students were generally unable to simplify to the given result. A few even tried to use the sum of n terms formula with $n = 3$, but without any success.

Part (b) was answered extremely well (for many students these were the only marks they scored in this question) with the vast majority correctly deriving or stating both values of k, by factorisation, quadratic formula or directly from their calculator.

The responses to part (c) were mixed. Most who attempted this part could correctly derive a value for r (using either value of k found earlier). However many found the reciprocal of r (5/4 or 1/6) and a few considered the difference of successive terms. While many students correctly derived the sum to infinity as 125 it was surprising how many students did not appreciate or take on board the fact that due to the series being convergent the value of the common ratio must be between -1 and 1 (therefore the value of $r = 6$ from $k = -6$ should have been rejected). Many decided to give two values for the sum to infinity and so therefore failed to score the last mark in this part. Errors were sometimes made in failing to use the correct value for a, with $a = 20$ a common error.

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