Examiners' Report
Principal Examiner Feedback

Summer 2017

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 80 out of 125. Timing did not seem to be an issue either, with most students able to complete the paper. There seemed to be a big improvement in attempting "show that" questions.

Students should be encouraged to set their work out in a logical manner. Points that could be addressed by centres for future examinations are;

- a failure to give exact answers or answers to the required degree of accuracy. This was evident in questions 4b, 9i and 15c
- an over reliance on graphical calculators when answering questions that state "show your method clearly", "solutions based entirely on graphical or numerical methods are not acceptable" or "Hence..." This was evident on questions 4b, 5c. 8c 11b and 12c.

Reports on Individual Questions

Question 1

This was a straightforward first question and allowed most students to settle well and score full marks. Very few students attempted to use formulae for geometric series. Part (a) was almost invariably correct, but occasional mistakes included confusing *a* or *n*. There were sometimes arithmetical errors in (b) and a few students used the same value of *n* as in part (a).

Question 2

This was a straight forward question on the laws of indices, but errors were common.

(a) This part was answered well by nearly all students who successfully simplified the expression to $\frac{1}{3}x^2$ using the laws of indices. The most common error was forgetting to take the square root of $\frac{1}{9}$ resulting in an incorrect answer of $\frac{1}{9}x^2$.

(b) This part was generally well done with many students either giving $2x^{-2}$ or $\frac{2}{x^2}$.

A small minority of students were unsure of how to handle negative indices and the resulting fraction. Although the question clearly required that answers should be simplified fully too many answers were left as $\frac{x^{-2}}{\frac{1}{2}}$ or $(0.5x^2)^{-1}$. Some students appear to confuse an index of -2 with a square root.

(c) Attempts at this part had a lower success rate than on parts (a) and (b). Successful students treated surds and indices separately and simplified wherever possible at each stage of their solution. Far less successful were students who rewrote $\sqrt{\frac{48}{x^4}}$ as $(48x^{-4})^{\frac{1}{2}}$ and were then unable to proceed. The most common reason for losing a mark was for not fully simplifying so that many potentially correct answers lost the A mark. Many excellent efforts got as far as $\frac{x^3\sqrt{3}}{4\sqrt{3}}$, but then failed to recognise that this could be simplified further.

Question 3

Most students found this question straightforward, with many achieving full marks. Most were able to identify correctly the gradient of l_1 and those who did so usually used this value and the point (3,-5) to arrive at the correct equation of l_2. A common mistake, however, was to use the gradient for a perpendicular line rather than a parallel line. A few students were not awarded the final mark as they failed to write the equation in the required form.

Question 4

Good students answered this question well, but weaker students found the index work a challenge.

Part (a)(i) and (ii) Those students who wrote the equation of the curve correctly in index form were usually able to find the first and second derivatives but many were unable to deal with $4x\sqrt{x}$ in the first term.
The most common errors in part (i) and (ii) were a result of poor surd manipulation, difficulties in handling negative fractional indices and incorrect fraction arithmetic leading to incorrect coefficients and/or indices in the differentiated expression. A few weaker students were unaware that the $\sqrt{8}$ differentiated to zero.

Part (b) Most students understood that they should set dy/dx = 0 in order to find the stationary point and many were successful in finding the value for x. The most successful attempts were made by those students who rewrote their expression for dy/dy as surds and fractions, as they found it far easier to solve the resulting equation.
A quite popular error was to square the terms separately in $x^{\frac{1}{2}} - 4x^{\frac{-3}{2}} = 0$ to obtain $x + 16x^{-3} = 0$ or even $x - 16x^{-3} = 0$, which results in the correct answer from incorrect working.
A few students set out to put $\frac{d^2y}{dx^2}$ equal to 0 in their quest to find the stationary point. Many students did found this part difficult and whilst they knew to set the first derivative equal to zero they were unable to manipulate the fractional indices and solve the equation correctly.
It was disappointing that many students who had been successful thus far then omitted to substitute x=2 in order to find the y coordinate of the turning point and therefore lost the 2 final marks in part (b)

Part (c) This part of the question was generally completed well. Most students gained at least one mark as they understood what was required and substituted their value of x into their d^2y/dx^2, obtained a result and gave a correct statement and conclusion. However a disappointing number of students just stated that d^2y/dx^2 was positive without making any attempt to substitute their value for x into their expression.

Question 5

In parts (a) and (b), while most students used the remainder and factor theorems as required by the question, some used long division and failed to get any marks. Apart from this, the correct remainder was usually found in (a) while in (b) many students omitted to write a conclusion, losing a mark.
The result of the long division in part (c) was usually correct, but quite a large number of students then struggled to factorise $-4x^2 + 4x - 1$ successfully, often finding difficulty in dealing with the negative coefficient of x^2. The most common error was to end up with $(x-3)(2x-1)^2$. A good strategy here would have been to take out initially a factor -1.
Few students succeeded in scoring both marks in (d), with many failing to understand what was required, sometimes confusing this with a quadratic inequality. Most scored one mark since they knew that 0.5 and 3 were significant, but they did not use the diagram to see how these values could then be used to find the full set of values for x.

Question 6

Part (a) The majority of students scored both marks as a result of correct use of the cosine rule. A minority of students made the incorrect assumption that the triangle was right angled in seeking to find the missing angle. Some students attempted to find one of the other two angles first and then went on to use the sine rule to find angle BAC. Errors were more common using this longer method. Common errors included substituting incorrect numbers into the formula, the most common such error involved using 10 twice rather than side lengths of 12 and 10. A minority of students gave the answers in degrees or did not give their answer to the required level of accuracy and consequently lost the accuracy mark.

Part (b) A very high proportion of students used the correct formula for the arc length with their answer from part (a) and continued to find the correct perimeter. Some students found the correct arc length but then added this total to the side lengths of the triangle and gave answers involving 10 or 12 for their final solution. A minority of students found the arc length only and failed to an answer for perimeter.

Part (c) The most common error was for students to assume that the triangle was right angled and use ½bh to find the area of the triangle. The majority of students used the correct formula for the area of a sector and a valid method for area of the triangle and were therefore able to score at least three marks out of four. Some students attempted to use the formula for the area of a segment but they were usually unsuccessful.

Question 7

Part (a) Most students attempted to find the coordinate of the minimum point and many were successful although a significant number chose to multiply 2 by ¼ and thus ended up with the answer (½, 5) rather than (8, 5).

Part (b) Many students successfully found the equation of the asymptote. Some students failed to give their answer in the form of an equation, stating just "7" and therefore losing the mark.

Part (c) Only a few students were able to make a meaningful attempt at this part of the question. Of those who made an attempt, many gave discrete values for k such as $k = 5$. Those who did give a continuous range answer often made an error with one or both of the boundary values. Common errors included $2 < k < 10$, and $k < 9$ or $k > 4$. A minority of students used incorrect inequality signs, either $\leq$ or $\geq$, or had their inequality in an incorrect form such as $5>k<10$. Some students wrote x or y instead of k.

Part (d) A high proportion of students scored full marks on this part of the question. A minority of students attempted to reflect in the y axis rather than the x axis or did a translation instead. Those who reflected the curve correctly generally went on to score all three marks.
Marks were lost by some students who placed their maximum incorrectly or did not give the equation of the asymptote. Others did not draw their curve so that it was asymptotic.

Question 8

This question was generally well answered with many students scoring most of the marks.

Part (a) The most common reason for losing a mark was by omitting the constant. Occasionally a student failed to simplify all of the terms, but the majority of students scored all three marks.

Part (b) Again many students scored both marks, although a significant number lost the accuracy mark as a result of working which was not fully correct. Missing brackets or sign errors in the removal of brackets, or failure to show all steps in the proof all cost students marks.
There is always the need for students to recognise the requirements when a question says ‘show’.

Part (c) Large numbers of students scored all three marks on this part. The most common failure to do so was a result of failing to state the solution b = 0. Sometimes students cancelled b from the cubic and discarded the solution b=0 in the process.

Question 9

In part (a) the majority of students used the power rule for logs successfully, but not all appreciated that $0 = \log_{10}1$. The alternative approach of moving $\log_{10}(x + 5)$ to the right hand side of the equation was less common but, when used, was on the whole more successful as it did not require the use of $0 = \log_{10}1$. Once the quadratic equation had been found, most could find two correct solutions but many failed to realise that one of these solutions was invalid, being negative. Despite the requirement for an exact answer, some students gave only a decimal version.

Part (b) was often answered more successfully. Most students used the subtraction rule correctly and also appreciated that $1 = log_p p$. Many achieved the correct equation but a significant minority failed to manipulate the equation successfully to make *y* the subject. Some students still had *y* on both sides of their final answer.

A small minority seemed to have no idea how to use logs.

Question 10

Whilst most students managed to score some marks on this question, the proportion scoring full marks was small.

Part (a) Most students used the binomial expansion and this process proved to be a familiar one for them. The minority who used a power series method were generally less successful. 1024 or 2^{10} was usually found as the first term. The most source of errors in terms 2 and 3 was in using (x/8) rather than (-x/8), whilst some students made numerical errors in reducing the coefficients to simplified form.

Part (b) Of those students who attempted this part, the majority succeeded in scoring both marks. It was not uncommon to see the statement 1024a = 256 followed by a=4 which is disappointing at this level!

Part (c) Only a small proportion of students succeeded on this part of the question, with many setting up an equation which had two terms rather than three. Some students wrote down equations which involved x and then failed to proceed to an equation involving only a and b.

Question 11

Part (a) of this question was well done with the vast majority of students legitimately achieving the given answer. Just a few opted to list year by year values rather than to use the formula. Occasionally wrong values of r such as 1.5 were seen. Too many students went on throughout the question using an incorrect value of r, but they should have known this was a mistake when they did not obtain the given answer 6274.

A few students tried to use a sum formula in part (b), but most were able to form a correct equation or inequality, then to use logarithms correctly to obtain a value for N.
Sometimes, having reached $N > 20.3$, answers such as $N = 20$ or $N < 21$ were given. If N instead of $N - 1$ was used in the term formula the last two marks were often lost as the answer $N = 20$ was usually given. Those who were unsure of logarithms resorted to using their calculator, often showing insufficient working to gain full marks.

If students managed part (b) they generally performed well in part (c), although quite a number failed to obtain the last two marks by dividing by 5 rather than multiplying or by ignoring the 5 altogether. The majority of students who listed the 10 terms made an error in adding.

Question 12

This question proved to be a good discriminator, with a wide range of marks.

In part (a) the majority of students differentiated correctly and substituted $x = 4$ into their derivative achieving the correct value of 2 for the gradient at this point. Occasionally, however, the correct gradient was stated without evidence so it was unclear whether the given answer was being used. The vast majority of students who were able to find the correct value of the gradient at $x = 4$ were also able to arrive at the given equation of the normal.

In part (b) the majority of students substituted $x = 1$ into y and obtained $y = 0$. However, a significant minority of students did not score this mark because they did not show any substitution, some simply stating that when $x = 1$, $y = 0$. A few students attempted to substitute $y = 0$ and arrive at $(x - 1)(x^2 - 8x + 18)$ by inspection or division. However, very few who tried this approach were successful.

Some students produced very good solutions to part (c) but there were also many who demonstrated a lack of understanding of how to calculate the 'compound' area. Some assumed incorrectly that this was a standard 'line minus curve' solution. The instruction to use calculus led nearly all to integrate the equation of the curve even if no further progress was made. For those that continued, finding $x = 16$ was usually done as a matter of course. There was sometimes confusion over which triangle area was to be calculated. Regardless of the method chosen the final combination of areas was sometimes a major challenge

Question 13

Part (a) This part was well attempted by a large number of students and there were very few who were not able to attempt this question and gain at least some marks.

Most students were able to use the $tanx = \frac{sinx}{tanx}$ and $sin^2x = 1 - cos^2x$ identities correctly in the given equation to gain method marks.

The most common mistakes here were:

(i) Not multiplying through correctly by cos x, often missing one of the terms.

(ii) Careless notation such as $sinx^2$instead of sin^2x and cos   instead of $cosx$ which lost the last accuracy mark. However although some students lost the final A mark for poor notation, this was a minority. A significant number of students scored full marks here.

Part (b) A significant proportion of students ignored or did not understand the 'hence' of the question and unnecessarily repeated all the steps of the proof in (a) to reach the first step in (b) and rewrite the question as $6\cos^2 2\theta + \cos 2\theta - 1 = 0$.

Most students were able to factorise the quadratic and correct values of $\frac{1}{3}$ and $\frac{-1}{2}$ were usually found for cos2θ or a replacement variable. A common approach was to use another variable such as x to replace 2θ to simplify working and in most of these cases the student did remember to convert back at the end of the question. Most students found one correct value for 2θ, and then for θ. Subsequent work was far less successful. To find a further value for θ, many subtracted their value for 2θ from 180 rather than 360. An even more popular misunderstanding was to subtract their value for θ from 360. Premature rounding caused many to lose the final A mark, in particular reaching 144.8 instead of 144.7 degrees.

Question 14

Solutions to part (a) were usually correct, with most students being able to find the midpoint of a line by formula or from ‘first principles’. Subtracting and halving, however, rather than adding and halving was a common error.

In part (b) many students found the radius by using the coordinates given to calculate the diameter and then successfully halved it, although some found the distance between one of the given points and their centre. Again answers were usually correct.

Most students, however, found part (c) difficult. Most knew that the equation would be of the form $x^2 + y^2 = r^2$, but then were not sure how to find r. A common error was to use the coordinates given earlier in the question rather than to find the distance of the centre from the origin. Some were able to find the equation of the circle which touched externally ($x^2 + y^2 = 13$) but did not understand how a second circle was possible. A lengthier method, seen very occasionally, was to find the intersection points of the given circle and the straight line $y = \frac{3}{2}x$ and to use these coordinates to calculate the respective radii. Only rarely was a sketch seen which gave the impression of a correct understanding of how the circles were positioned.

Question 15

Students were able to score the mark for part (a) quite easily. A number converted from radians to degrees to get the correct answer.

The most common error in part (b) was to substitute $t = 2$ instead of $t = 14$. Although this gave the same answer it was unacceptable unless further explanation (about periodicity) was offered. Accuracy errors sometimes arose from having calculators in degree mode.

In part (c) most students were able to substitute $H = 3$ correctly and to proceed to a value for $sin\left(\frac{\pi t}{6}\right)$. Problems arose, however, when they failed to realise how to interpret the negative value arising from the inverse sine of $-\frac{2}{3}$. Various methods were employed to find correct solution(s). Most students looked at a ‘quadrants’ solution with a few using sine graphs to assist them. Some tried $\pi + \theta$ and $2\pi - \theta$ but still had θ as a negative value, giving them solutions in the wrong quadrants. Where students arrived at correct solutions in terms of hours some did not convert these into actual times or failed to use 24hr clock or am / pm times appropriately.

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