Examiners' Report

Summer 2016

Pearson Edexcel IAL in Core Mathematics 12 (WMA01/01)

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Mathematics Unit Core Mathematics 12

Specification WMA01/01

General Introduction

Students found this paper accessible. The quality of responses seen was high, showing that students had been well prepared by their teachers. Q05, Q07, Q10, Q12 and Q13 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. Points that could be addressed in future exams is the lack of explanation given by some students in making their method clear.

Report on Individual Questions

Question 1

Nearly all students were able to make a good attempt on this question. A few struggled to access the question through not understanding that their expansion $(1+px)^8$ was intended to be equated to the given expression. There were problems with the quadratic coefficient, where students would be well advised to use brackets around each part of the term in order to avoid errors. Numerical errors were rare in this question. Some students found $p=\frac{3}{2}$ but did not square it in their attempt to find q so ended up with $q=42$.

Question 2

Q02(a) was answered well by the vast majority of students. Answers were given as improper fractions as well as decimals. The most common errors included arithmetical errors, writing the wrong inequality sign, or failing to multiply out the brackets correctly.
In Q02 (b) the majority of students found the correct critical values though some students did so by multiplying out the brackets and then re-factorising. Many students drew sketches but, of these, some chose the wrong part of the sketch in producing their inequality. The word "and" was often used by students, losing the final answer mark.
Due to errors in earlier parts of the question the majority of students scored no marks for Q02(c). Of those students who had scored full marks in Q02(b) many still failed to gain the mark for this part as they only produced one of the two inequalities.

Question 3

In Q03(i), those that started this question with an attempt to write both terms as powers of 2 or 4 generally went on to gain all three marks. There were some errors in expanding the brackets, but these were rare. Most students, regardless of earlier errors, recognised a need to equate the powers, but some did not score the second method mark as it was dependent on using the same base. The alternative method using logs was attempted by a small minority, often starting well and gaining the first mark, before stumbling as a result of being unable to clearly evaluate their logs without a calculator, a requirement of the question.
In Q03(ii)(a) the vast majority scored both marks, with few students being unable to simplify the surds. It was very rare to see any attempt to subtract within the square root.
Some failed to understand the requirements of Q03(ii)(b), but apart from that, the main issue was that students arrived at $\sqrt{50}$ and felt it appropriate to stop, thinking they had answered the question.

Question 4

Q04(a) was well answered, with most students gaining the mark, although some were unable to round correctly to 4 decimal places.
Solutions to Q04(b) were usually a well-structured attempt at the trapezium rule, with the most common error being the use of $\frac{(6-(-2))}{5}$ to find the width of the trapezia. There were some bracketing errors, and students sometimes used the wrong y values as the first and last term, but attempts were generally correct and to the required level of accuracy.
Q04(c) proved to be discriminating, with a large number of students attempting to integrate the expression, rather than to follow the instruction 'Use your answer to part (b)'. In Q05(c)(ii) some integrated 2 between -2 and 6, gaining a method mark, but others simply added 2 to their answer to Q04(b). Some students adapted the values from Q04(b) and achieved correct answers by using the trapezium rule again with their new values.

Question 5

In Q05(i) the vast majority of students completed Q05(a) of the question successfully. When this was done correctly the majority of students recognised that for Q05(b) they just had to calculate 100×4. Those who used the sum formula were also mainly successful but a common error was to get an incorrect common difference, very often giving this as 1.

Q05(ii) was not seen to be as accessible with many students making $3r > 100$ rather than recognising the need to involve the sum of an AP. The other common error was to make the common difference 3 instead of -3 which, because of the dependent method mark, cost them all 3 marks. Of those who got to the correct equation it was generally solved well but common errors were with adding the 2×97 to the 3. Some did not arrive at a quadratic equation as a result of losing the ' n" from outside the brackets. Students need to take care with the use of inequality signs as their incorrect use can lose them marks. Finally, a number of students lost the final mark because they failed to conclude with an integer value for n, leaving their answer as 65.6.

Question 6

In Q06(a), students found it difficult to divide by the denominator and deal with both the powers **and** the coefficients. One of the common errors was forgetting to divide by the 2 on the second term, giving $-4x^{-0.5}$. Some students produced three terms instead of two, usually scoring no marks in this part. Various other mistakes were seen, but most students were able to score at least one of the three available marks.
Integration attempts in Q06(b) were usually good, with most students being able to integrate a term with a fractional power and gain some credit after earlier errors. Many omitted the integration constant, losing the final mark. Just a few used differentiation instead of integration.

Question 7

There were many excellent solutions to Q07(a) and Q07(b) , but Q07(c) proved more discriminating.

There were few problems with Q07(a), although some students, having found f(2), did not make it clear that they were equating this to zero. Although this part of the question required the use of the factor theorem, there were just a few (unsuccessful) attempts at dividing f(x) by $(x-2)$.

In Q07(b) just a few students had $f(-1)=0$ rather than $f(-1)=-36$, but apart from this, the main mistakes were with signs or simultaneous equation arithmetic.

Those who understood the demands of Q07(c)(i) were usually able to divide their cubic accurately by $(x-2)$ to find a quadratic function Q(x), but while the use of the discriminant (or another method) was commonly seen in Q07(c)(ii), students were often unable to interpret their result or to give a convincing conclusion. It was important here to comment on the significance of the negative sign of the discriminant.

Question 8

Q08(a) was generally well answered with the vast majority of students working to the given answer confidently and with few errors. $\cos^2\theta=\sin^2\theta-1$ was occasionally seen, but students who were not able to access this part of the question were in the minority. It was pleasing that most students used the notation correctly, so that very rarely was the final mark lost for incorrect positioning indices or for mixed variables. The most common error was to replace each of the $\cos\theta$ terms by $1-\sin\theta$.

Q08(b) was also answered well, with most students able to get to the correct values of $\frac{1}{3}$ and -$\frac{1}{2}$ for $\sin\theta$. However, a significant number of students went on to obtain $\theta=19.5$ correctly but then wrote $\theta=30$ (from $\sin^{-1}(\frac{1}{2})$) instead of -30. A number of students lost the last mark as a result of failing to round their 19.4... to 19.5. A few students wrongly gave extra angles within the range such as 70.5 and 60.

Question 9

For Q09(a)(i) most students gained the method mark with many going on to achieve the correct answer. A few students incorrectly wrote down an answer to 1 decimal point gaining A0. A handful of students used the S_n formula rather than U_n.

Q09(a)(ii) was largely done correctly with almost all students using the sum to infinity formula correctly and gaining 75 as their answer.

In Q09(b) a small number of students used the incorrect formula, either the sum of an arithmetic series or the nth term formula, gaining no marks. Of those who used the correct formula, some students failed to rearrange the inequality correctly. The most common algebraic error was in multiplying out the brackets, with for example

$6(1-0.92^n)$ leading to $6-5.52^n$

A very small number of students used '=' throughout leading to the correct answer of $n = 38.6$ and knowing that therefore $n = 39$

Most students started by setting $\frac{6(1-0.92^n)}{1-0.92} > 72$ with the majority of students correctly rearranging to gain the correct answer of $n > 38.6$ leading to $n = 39$. However not all students gained full marks from this because of their use of inequalities. The inequality symbol reversed twice during the rearrangement which meant that those that ignored this would have correct answer but gained A0 for the final mark as the solution was not completely correct.

Many students who did get as far as $-.92^n > -0.04 \Rightarrow 0.92^n < 0.04$ failed to recognise that $n\log(0.92) < \log(0.04) \Rightarrow n > \frac{\log(0.04)}{\log(0.92)}$ Some failed to recognise both steps. The small number of students who worked out log(0.92) and log(0.04) before dividing realised they were dividing by a negative number and hence changed the inequality symbol accordingly. Some students went from $0.92^n < 0.04 \Rightarrow n > \log_{0.92}(0.04)$ but a large number did not use the correct inequality symbol.

Question 10

In Q10(a) most students were able to produce a curve with a maximum and a minimum. Many failed to see the graph as a translation of $y = \sin x$ and drew their graphs passing through the origin. Other common mistakes were to have the maximum on the *y*-axis or to sketch only the part of the curve up to $x = \frac{7\pi}{4}$

For Q10(b) the *x*-intercepts were often achieved either in degrees or in radians even though answers sometimes contradicted their sketches. The *y*-intercept was often missing, or given as a rounded decimal or as (0, 1).

There was sometimes a reluctance to work in radians when solving the equation in Q10(c), and occasionally degrees and radians were mixed in the same equation. Many, however, achieved one correct solution $\frac{\pi}{12}$, while fewer were able to produce the second solution $\frac{5\pi}{12}$, with $\frac{11\pi}{12}$ being a popular incorrect answer. A small number of students started by writing $\sin(x + \frac{\pi}{4}) = \sin x + \sin\frac{\pi}{4}$

Question 11

Q11(a) had a large number of students simply stating that $2.4 - 0.4 = 2$. Of those students who recognised the need to make use of Pythagoras, a significant number wanted to assume $r = 2$ prematurely. Only a modest proportion of students adopted the approach using Pythagoras with lengths $r,\ r - 0.4$ and 1.2 These students then usually went on to complete the proof successfully.

Generally Q11(b) was well done with the vast majority choosing the cosine rule to solve for the whole angle. These students usually achieved both marks. With those students who first found the half angle, a degree of tolerance was applied to condone premature rounding on the way to the value 1.2870.

Q11(c) was tackled successfully by the majority of students with many gaining all four marks. Students need to take care however, to describe what they are doing with statements such as “area of sector =...” rather than just writing down formulae without further explanation. By doing so they enhance their chance of gaining method marks despite failing to achieve the final answer. There was a fairly even split between those students who used areas for sector and triangle before subtracting and those who quoted and applied the formula for the area of a segment.

Question 12

In Q12(a) most students tried to use the equation for a circle, with $(x - a)^2 + (y - 0)^2 = ...$ but, unfortunately, significant numbers failed to recognise that the radius was "a" thus settling for r^2 rather than a^2. There were also occasional sign errors with regard to $(x - 1)$ and $(y - 0)$.

Those students who had answered Q12(a) successfully almost always went on to get full marks in Q12(b) with only occasional manipulation errors after correct substitution.

Question 13

In q13(a) the majority of students scored at least one of the method marks for using the power or the addition "log law" correctly. Many were able to derive the correct equation with a neat manipulation of logs. Most of the successful students collected the logs on the LHS, equated to 5, and then removed logs to get 2^5 but a few incorrectly wrote 5^2. Some students replaced 5 with $\log_2 2^5$ and successfully collected logs to complete a fully correct solution. A small minority of students displayed poor knowledge of the laws of logs with some writing 5 as log 5 and removing logs to get $y^2 = \frac{5}{x}$.

Q13(b) proved to be more difficult with many students unable to 'undo' logs correctly. Without this step further progress was rare. However some scored a method mark by convincingly producing an equation in one variable. The successful students usually equated *y* from Q13(a) with x^{-3}but many were unable to deal with negative indices. The majority of those who tried to find the value of *x* first usually proceeded to find *y*. Those who tried to find *y* first by using $\frac{32}{y^2}$ as the base of the log often struggled to find the correct value $y = 8$.

Question 14

In Q14(a) students who attempted this question almost always attempted to find the gradient of each line segment. There were a few errors with finding the y-intercept with some students not looking at the graph to identify this. In going on to solve the resulting equation, the most common errors from students came when dealing with the fraction $\left(\frac{1}{2}x\right)$. Some multiplied by 2 but did not multiply all terms whilst others struggled to subtract/add. Many students found the y-coordinate as well which was not needed. Most students who attempted the question understood the demand to leave their *x* coordinate as a fraction.

The great majority of students scored full marks for Q14(b), including those who had had little or no success with Q14(a). Common amongst the errors that were made, included multiplying the incorrect coordinate, miscopying their list of correct coordinates onto the diagram or applying an incorrect transformation.

Question 15

Poor knowledge of surface area and volume formulae made Q15(a) difficult for some students, although there were many good solutions. Most were able to equate the volume of a cylinder correctly to 60000 and to rearrange to give an expression for h or πrh. A significant number, however, had an incorrect formula for the surface area of an open cylinder. Some failed to show sufficient working to be awarded full marks. It is important that all stages of a 'show that' solution are written down.
In Q15(b) most students were able to differentiate correctly. However negative indices proved difficult for many with a significant number unable to solve $\frac{dS}{dr} = 0$ correctly or even to proceed as far as r^3 = ... Many students stopped after evaluating *r*, not continuing to find the value of *S*.
In Q15(c) the vast majority attempted to use the second derivative to prove that the value of *S* was a minimum. One of the most common errors at this point was to lose 2 when differentiating the second term. Other marks were lost on this part of the question when students stated the second derivative but then failed to show any method to prove that *S* was a minimum value. A reason (second derivative positive for the value of *r*) and a conclusion were required to score the final mark here.

Question 16

In Q16(a) most students were able to gain at least one mark. The majority proceeded to successfully multiply out the brackets and virtually all then went on to differentiate term by term. Where marks were then lost, it was in differentiating the $2x$.
In Q16(b) most students were able to attempt this with many getting as far as a correct equation for the tangent. However, only a minority read the question carefully, failing to express the equation in the form $ax + by = c.$. Errors which prevented students from scoring marks included obtaining the normal equation rather than the tangent.
In Q16(c) the most able students demonstrated and described a good strategy to find the shaded area. Those who dealt with the area between the line and the *x*-axis separately to the area between the curve and the x axis tended to achieve more marks. Of those students who used integration between $x = \frac{1}{2}$ and $x = 2$, many were unaware of the need to then deal with the area below the x-axis between $x = 1$ and $x = 2$. A few students chose to integrate between $x = 0$ and $x = 2$ and were therefore unlikely to score more than two marks. A small number of students chose to use calculators in order to achieve values for integrals. The question stipulated the use of integration so that such attempts could not achieve good marks. Overall, this final part of the final question successfully enabled the most able students to demonstrate their quality.

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