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Examiners' Report/
Principal Examiner Feedback

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Pearson Edexcel International A Level
in Mathematics C12 (WMA01)
Paper 01

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Core Mathematics C12 (WMA01)

General Introduction

Overall the questions were fairly straightforward for the candidates, who had prepared themselves well for this exam. The majority set out their work neatly and methodically and there did not seem to be a problem completing solutions in the time available. The standard of algebra appeared to be better on the whole than seen on C1 and C2. The numerical errors seen on C1 were not evident on this fully calculator paper.

However, many candidates did not read the questions carefully enough often leading to extra answers given outside of the range stipulated. Too many solutions had insufficient working to demonstrate that the appropriate method had been used. All working should be shown with the solution to the question in the answer book and not done separately in rough. Pencil should not be used as it is difficult to read and scrap paper is not acceptable. Candidates should be encouraged to work directly through their answers.

Report on Individual Questions

Question 1

68% of the candidates gave fully correct responses to this question and only 5% gained no marks at all. Among the other solutions seen the binomial coefficients were usually correct and generally candidates were trying to apply the structure of the binomial expansion correctly. Common errors included expanding in terms of $\frac{x}{2}$ rather than $-\frac{x}{2}$ and leaving the 2 out of the expansion. Those who used the alternative method sometimes took just 2 outside a bracket rather than 2^6.

Question 2

This question was well attempted by the vast majority of candidates with 64.6% scoring full marks and 85% gaining at least five of the seven marks. With very few exceptions f(x) was differentiated in part (a) and integrated in part (b), although in (b) a few candidates integrated the expression they had found from part (a), so returning to f(x). In part (a) many answers were completely correct but some candidates had difficulty with the first term producing a wrong sign and/or power, however most coped well with the $x^{\frac{1}{2}}$ term.

Part (b) was well answered with the majority of candidates gaining at least three marks, although wrong simplification of terms often led to the final mark being lost; the most common reason being in dealing with the fraction in the denominator of the $x^{\frac{3}{2}}$ term. Occasionally –1 was integrated to "c" and so the –x term was lost, and it is worth noting that many candidates failed to include the constant of integration, which resulted in the loss of the final mark in an otherwise correct answer.

Question 3

Overall this question was well done with 70% being excellent solutions which scored the full 7 marks, and a further 17% losing just one or two marks.

(a) The majority of candidates used the Remainder theorem, usually reaching the correct answers. Those who chose long division were more likely to make mistakes and did not always make the value of the remainder clear.

(b) Once $(x + 3)$ was recognised as a factor this was usually followed by long division to identify the quadratic factor, if it had not already been done in part (a). A few candidates did not continue to factorise the quadratic and lost the last two marks. Of those who went on to complete the factorisation there were occasional errors but it was mostly well done. There were a few who went on to give the roots of $f(x) = 0$ unnecessarily. Sometimes the factorisation was begun by stating the roots and using them to form the factors, but this approach usually led to errors or incomplete solutions. A few candidates failed to write all three factors together.

Question 4

In this question candidates were required to show all of their working and were told not to use a calculator, and although 60% of candidates clearly did this and produced completely correct solutions, the presentation by some of the other candidates was poor and unconvincing, with critical steps in the solution omitted.

In part (a) the majority of candidates attempted to rationalise the denominator, although multiplying by $[2\sqrt{2} + 6]$ instead of $[2\sqrt{2} + \sqrt{6}]$ was fairly common.

The result $4\sqrt{2} + 2\sqrt{6}$ was sometimes just written down with no supporting evidence, suggesting the use of a calculator. The mark for reducing the denominator to 2 was sometimes lost, but most of those who gained the first two marks managed to complete the question correctly.

The use of $[\sqrt{8} + \sqrt{6}]$ seemed to make the denominator easier to deal with for some candidates but then caused them difficulty with the numerator. Occasionally the given expression was neatly reduced to $\dfrac{2\sqrt{2}}{2 - \sqrt{3}}$ which led directly to the answer in the required form.

In part (b), although many candidates gained full marks, it was common to see only one or two marks scored. The majority of candidates were able to reduce the first two terms to $10\sqrt{3}$ but those who wrote down the given answer straight from $10\sqrt{3} - 6/\sqrt{3}$ lost the final marks of this question. It was also quite common to see candidates misinterpret the term in the question as $\sqrt{27} + \sqrt{21}(\sqrt{7} - \dfrac{6}{\sqrt{3}})$.

The alternative method of combining the fractions to obtain $24\sqrt{3}$ was popular and most candidates completed this successfully, although the final mark was sometimes lost for not showing how $8\sqrt{3}$ was derived.

Question 5

In part (a) the vast majority of candidates were able to use the recurrence relationship successfully to generate the next three terms. Arithmetic was generally accurate, although $u_4 = 2 - \dfrac{4}{-4}$ was occasionally seen as +1, and a minority re-interpreted the relationship incorrectly as $u_n = 2 - \dfrac{4}{n}$.

Candidates that identified the periodic nature of the sequence usually went on to get all the remaining marks. However, significantly 44% of candidates gained 3 marks or fewer (usually on part (a)) and only 31.7% gained full marks.

In part (b), however, only about half the candidates gave $u_{61} = 3$, and many either abandoned this part or attempted to use the formula for the 61st term of an arithmetic progression, with various values for a and d.

Part (c) proved a very good discriminator. The better candidates had little difficulty evaluating the correct result, mostly using the sum of the three results to part (a) multiplied by 33. A few used 99 instead of 33. However part (c) proved beyond the weaker candidates, who either made no attempt or tried to apply a sum formula for an arithmetic progression, thus gaining no marks.

Question 6

Most candidates appeared to know how to go about solving this question with 66% achieving full marks and a further 6% losing just one mark. There were, however, almost 13% who gained no credit and seemed to have no understanding of logarithms.

Generally the laws of logarithms were applied correctly. Those candidates who substituted for a or b before removing logs were not always successful as they could not deal with the ‘nested fraction’ correctly. Others solved the problem perfectly but also gave the negative pair of solutions and lost the final mark. Sometimes $3^4 = 81$ was seen instead of $4^3 = 64$.

Those that tackled the question by rewriting $ab = 25$ in terms of logs were less likely to be successful than those that unpicked the other equation to arrive at $a = 64b$ or similar.

There were some instances of incorrect application of the power law, for example log $\dfrac{a^2}{25}$ being rewritten as 2 log $\dfrac{a}{25}$.

Question 7

This question was generally well done with 57% gaining the full five marks and a further 18% losing just one mark.

(a) Replacing $\sin^2 x$ by $(1 - \cos^2 x)$ was by far the most favoured method and if there were errors they were usually careless ones, such as sign slips or miscopying coefficients.

(b) Most candidates recognised that they were to use the changed equation and went on to solve a quadratic, sometimes using an alternative variable to simplify it. When finding their values of x from the solutions the most common error was to include excess values within the required range (such as 70.5). A few candidates, having correctly found the cosine values $\frac{1}{4}$ and $-\frac{1}{3}$ decided to reject the $-\frac{1}{3}$ and finished with only two of the required four solutions.

Question 8

Although 33% of the solutions were fully correct, many candidates were let down by slips in algebraic manipulation and errors in manipulation of inequalities.

Most candidates knew that they had to use $b^2 - 4ac < 0$ and most correctly identified *a, b* and *c*, although *c* proved a little troublesome. Candidates were able to gain 4 marks for finding the correct critical values involved, and although the majority were successful in finding $k = -8$ and $k = 1$, errors in manipulation, such as $-4k\{2(k+7)\} = -8k^2 + 28k$, and $-4k\{2(k+7)\} = -4k(2k+7)$ were quite common and usually led to 2 marks being lost at this stage.

The most disappointing part of many solutions, however, was the poor manipulation of inequalities. Most candidates had now reached a stage where their quadratic inequality was of the form $-8k^2 + pk + q < 0$, which was then followed by $8k^2 - pk - q < 0$, seemingly unaware that multiplication by a negative number has a consequence. This led to a large number of candidates giving a result of the form $m < k < n$, usually $-8 < k < 1$, so losing the final two marks.

Question 9

Although there were many fully correct responses to this question (35.5%), errors of various kinds were common, especially in part (c).

(a) Candidates often left their answer as a decimal and therefore lost a mark, or they used a power of 24 instead of 23 and lost both marks.

(b) Solutions were more often fully correct than not, with the common error being to use a power of 23 rather than 24.

(c) While most candidates seemed to realise they needed to take logs to solve their inequality or equation, many failed to earn the last mark as they interpreted the inequality incorrectly or left the answer as a decimal. Some used the Sum formula for which they could have earned one mark for a 'correct' solution using logarithms. Sometimes a power of n rather than $n - 1$ was used, leading to the answer 48 instead of 49. Even those who reached $n > 48.2$ sometimes concluded $n = 48$.

It was surprising that despite the huge hint in the question a significant number of candidates treated the whole question as if they were dealing with an arithmetic series, or perhaps resorted to an arithmetic series in (b) and (c) after correctly dealing with part (a).

Question 10

Many candidates found this question difficult and there were a considerable number of blank responses. Completely correct solutions were rare (10.8%) and many graphs were poor both in quality and presentation.

(a) Very few scored both marks, but most were able to produce a curve with a minimum and a maximum. Common mistakes were to have the maximum on the y-axis and to extend the graph beyond the required limits.

(b) The correct x intercepts $\frac{5\pi}{6}$ and $\frac{11\pi}{6}$ were often achieved algebraically, scoring marks even when the sketch in part (a) appeared contradictory. Surprisingly, the y intercept was often omitted and (0, 1) was a common wrong answer. Some candidates worked successfully in degrees.

(c) By far the most common result here was to score 3 marks out of 4, with only one correct answer seen. If a second answer was given it was usually $\frac{25\pi}{12}$. If degrees were used to start the solution, a mixture of these with radians sometimes followed, leading to confusion.

Question 11

About 55% of the candidates gained full marks indicating an able group of candidates, as this question included two parts requiring proofs.

In part (a) candidates were asked to show that $p = 9$. The most successful routes involved equating the differences $[4p - 60 = (2p - 6) - 4p]$, knowing the sum of the first and third term was equal to double the second term $[60 + (2p - 6) = 2 \times 4p]$ or solving simultaneous equations in p and d. As the result $p = 9$ was given, there were a number of spurious equations "invented" which had that solution, and other equations that did not, but $p = 9$ still emerged, the most common being by adding all terms, so $60 + 4p + 2p - 6 = 0$, or otherwise subtracting all terms, so $60 - 4p - (2p - 6) = 0$.

In part (b) the majority of candidates attempted to use $u_n = a + (n - 1)d$, generally with $a = 60$ and $d = -24$ but it was not uncommon to see $d = 24$ at this stage, often subsequently corrected to $d = -24$ in part (c) . Some candidates were confused by their own presentation in calculating $60 + (20 - 1) - 24$ rather than $60 + (20 - 1) \times -24$. A small minority of candidates mistakenly used $d = 9$ (the value given for p).

Part (c) was very well answered with candidates setting up the correct initial equation for the sum and generally simplifying to the required expression with ease. It was encouraging to see a number of efficient and elegant solutions. Those candidates whose work was less well presented were more likely to make errors in sign or losing an 'n' during simplification.

Question 12

38% gained full credit for good solutions to this question, but it was disappointing to see marks lost unnecessarily due to early approximation of interim answers. Mixing degrees and radians caused all the usual errors in the use of the formulae but the majority of candidates used the appropriate formulae competently.

In part (a) the favoured method was the cosine rule and working for this was usually accurate. The last mark was lost sometimes, however, because the angle was given in degrees or to 3 significant figures instead of 3 decimal places. Some candidates gave the answer as the acute angle $\cos^{-1}(\frac{1}{8})$, despite having found $-\frac{1}{8}$ from their calculation.

(b) Apart from slips in the value of r, most candidates were able to find the length of the required arc, but then the most common error was to omit adding the 15, giving perimeter 61.3. A few candidates seemed to have no idea of the significance of 'perimeter' in this context.

(c) Some candidates found the height of the triangle and used $\frac{1}{2}$(base × height) but the trigonometric formula was chosen most often. A few quoted and used the formula for the area of a segment, confusing this with the required area. Apart from this, various other wrong formulae were seen, both for the sector and for the triangle.

Question 13

Many very good responses to this question were seen with 31.7% of candidates achieving the full 14 marks, and 49% achieving 12 marks or more.

(a) The division and subsequent differentiation were generally well done but some candidates had problems with algebraic manipulation. A few who had covered the quotient rule attempted this method, but it was very rare. Weaker candidates simply differentiated the numerator and denominator separately.

(b) This part was well done with most candidates realising that they had to set $\frac{dy}{dx}$ equal to zero, but a fair number gave extra unnecessary answers having ignored the condition $x > 0$.

(c) Most candidates found the second derivative and concluded that the point was a minimum but a few lost marks by not justifying their conclusion with reference to the positive value of the second derivative.

(d) There were many good solutions to this part. Most candidates correctly found the gradient by substitution into the first derivative but there were a few who used the formula for the gradient between two co-ordinate points and thus lost all the remaining marks. Some continued to find the equation of the tangent instead of the normal, losing the last 3 marks. Most candidates gave the equation in the required form.

Question 14

About 90% of candidates managed part (a) successfully and gained all 5 marks, although a few either neglected to find the *y* coordinates having found the *x* coordinates, or made an arithmetic slip in finding them, and a small number just attempted to solve the equation
$x^2 - 2x - 15 = 0$.

Part (b) proved a very good discriminator. The more able candidates (22.9%) had no trouble gaining full marks, succinctly finding the area of the triangle formed by the line, the *x*-axis and the line $x = 6$ and subtracting the area under the curve from $x = 5$ to $x = 6$, with the weaker ones struggling to score anything. However the majority of other candidates, whilst lacking a clear overall strategy for finding the required area, were still able to gain up to 4 of the 7 marks available, namely 2 marks for finding the intersections of the line and the curve with the *x*-axis, plus 2 more for integrating a relevant quadratic expression, which was generally done very well, and evaluating it by showing substitution of limits.

Candidates who integrated $x^2 - 2x - 15$ between the limits -2 and 6, and there were a large number of such candidates, often had a maximum of 2 marks available, although we saw a handful of candidates who did go on to produce a successful, if long, solution.

In general far too many of all candidates were guilty of a lack of thoroughness in showing the substitution of their limits in evaluating integrated expressions, and there were some who did not even show any integrated function but used their calculator to produce the result of substituting limits, e.g. $\int_5^6 (x^2 - 2x - 15)\ dx = 4\frac{1}{3}$. (This does not gain credit for integration or for use of limits as the question made clear the requirement to use integration.) Also, there was clear evidence that some candidates still do not appear to understand the meaning of the word exact, thereby forfeiting the final mark.

Question 15

38.3% of candidates achieved full marks and about 50% achieved 12 or more of the 14 marks available. Of the other candidates the majority were able to score well in parts (a), (b) and (c), but solutions to part (d) were varied, with some common errors occurring.

Part (a) was well done by most candidates with just a few getting the gradient upside down or miscalculating $11 - 3$ to obtain 9. Occasionally some candidates, surprisingly, found the distance XY instead of the gradient.

Part (b) was well attempted but there were some common errors: using an incorrect midpoint formula; using the gradient found in part (a) to find the equation of the line joining Z and M; or using one of the points (6, 11) or (0, 3) instead of the mid-point.

In part (c) the vast majority of candidates used their equation from part (b) to find the x-coordinate of Z, although some successfully equated expressions for the lengths ZX and ZY.

Whilst there were some excellent responses to part (d), there were several problems, often not helped by the lack of explanation for the methods used by candidates. Finding the radius of the circle proved more difficult than expected, and one of the most common errors was to use the length of ZM as the radius of the circle. The majority of candidates used a correct method for the equation of circle, after their varying attempts to find the radius.

Grade Boundaries

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