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**General Certificate of Education (A-level)**
**January 2011**

## Mathematics (Pilot) XMCA2

## (Specification 6360)

## Core A2

# *Report on the Examination*

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## General

The presentation of work was generally very good. Candidates appeared to have sufficient time to attempt all the fourteen questions in the 150 minutes.

Candidates generally answered the first four questions very well, but the unstructured question 9 and the final three questions proved to be a significant challenge to all but the most able.

## Question 1

The majority of candidates scored full marks in this opening question on the binomial expansion. The most common error was forgetting to square and cube the coefficient 4 when finding the values of $b$ and $c$ respectively.

## Question 2

The majority of candidates gained the three available marks, usually by solving relevant linear equations although the alternative approach of squaring was also used successfully in this modulus function question.

## Question 3

Most candidates had a good understanding of Simpson's rule, but some poor evaluations or miscopying of figures was seen in part (a). In part (b), examiners were looking for candidates to halve their answer to part (a). A common wrong answer was $\sqrt{2.86}$ , instead of the correct approach of $\frac{1}{2}\times 2.86$.

## Question 4

In part (a), most candidates were able to correctly write the expression in partial fractions. In part (b), the majority of candidates realised that the integration of the first two partial fractions gave logarithms but, when integrating $-\frac{1}{(x+1)^2}$ with respect to $x$, a significant minority gave an incorrect answer of $\frac{1}{2}(1+x)^{-1}$.

## Question 5

The majority of candidates scored full marks for their sketch in part (a). Other candidates normally gave the correct values for the intercepts but drew graphs which stopped at one of the axes. Most candidates gained the mark for the gradient of the line, but a significant proportion tried to solve the equation of the line and the equation of the curve simultaneously, instead of equating and solving the gradient of the curve and the gradient of the line. Some otherwise very good solutions did not score the final accuracy mark because the $y$-coordinate of the point $A$ was not correct.

## Question 6

Most candidates were able to correctly write the given expression in the $R$, $\alpha$ form. In part (b), a significant minority of candidates just found one value for $\theta$, despite the wording of the question: 'giving your value**s** of $\theta$'. In part (c), those who realised the link with part (a) generally scored well, but a significant number of other candidates gave translations with a variable component, treating '$-8\sin x$' as a constant, and using a stretch with scale factor $\frac{15}{6}$.

## Question 7

The majority of candidates picked up the mark for writing $\frac{dN}{dt}$ but only a minority of candidates gained further credit in part (a). It was pleasing to see candidates using the printed result in part (a), with more than half of them gaining full marks for finding the correct value for $t$.

## Question 8

In part (a), almost all candidates showed that they understood how to apply the chain rule with parametric equations but a significant majority failed to score the final accuracy mark, mainly because they could not differentiate $y$ correctly with respect to $\theta$. The majority of candidates used the two appropriate identities to correctly write $x^2$ in terms of $\sin 2\theta$, but only a minority could state the greatest positive value of $x$, with others sometimes just forgetting to take the square root and giving the answer '2'. The final part of the question, as expected, was found to be demanding. The most successful approach was to write $y$ as $\cos 2\theta$, then to use part (b)(i) to find $\sin 2\theta$, then to apply the identity $\cos^2 2\theta = 1 - \sin^2 2\theta$ to eliminate $\theta$. This leads to the cartesian equation $y^2 = 1 - (x^2 - 1)^2$.

## Question 9

Although most candidates attempted to find $\frac{dy}{dx}$ and equate it to 0, relatively few could provide a proof which contained sufficient detail and explanation. As in previous questions of this type, examiners were expecting candidates to state that $e^{-2x} \neq 0$ (or equivalent, for example $e^{-2x} > 0$) within the proof.

## Question 10

Almost all candidates scored full marks for the first two parts of this vector question but, in part (a)(iii), a large majority did not score the mark for the equation of the line mainly because they did not have an appropriate vector, $\mathbf{r}$ or $\begin{bmatrix} x \\ y \\ z \end{bmatrix}$, on the left-hand side of the equation. Most candidates applied a correct method for showing that the vector was perpendicular to the line but some others applied the scalar product to the wrong vectors in part (a)(iv). In part (b), it was clear that a significant majority of candidates were not able to recall the definition of skew lines. Relatively few candidates realised that to prove that two lines are skew lines it is necessary to prove both that the lines do not intersect **and** that the lines are not parallel.

## Question 11

Most candidates attempted to use the correct method — integration by parts — to answer part (a), but the integration of $e^{-3x}$ caused more problems than anticipated. In part (b), it was pleasing to see many candidates choosing an appropriate substitution to use in their evaluation of the definite integral. A significant minority could not see how to go beyond the stage $\int \frac{1}{2} \times \frac{(u-9)}{\sqrt{u}}\, du$. A majority of candidates who replaced this integral by $\frac{1}{2}\int (u^{0.5} - 9u^{-0.5})\, du$ went on to score the remaining marks. The others who had scored the first four marks generally either made arithmetical or sign errors or forgot to change the limits from 0 and 4 for $x$ to 9 and 25 for $u$.

## Question 12

In this short question on volumes of revolution a mark was awarded to candidates who gave a correctly written formula, including the '$\mathrm{d}x$'. The formula $V = \pi\int_0^{\frac{\pi}{4}} \tan^2 x \,\mathrm{d}x$ scored this opening mark. A significant majority made no further progress as they did not try to integrate $\tan^2 x$. Those who explicitly replaced $\tan^2 x$ by $\sec^2 x - 1$ in the integrand normally integrated correctly and went on to score the remaining marks.

## Question 13

Most candidates equated $\mathrm{f}(x)$ and $\mathrm{g}(x)$ and either squared or eliminated the fraction from the resulting equation. Unfortunately many candidates stopped at that point. More confident candidates, with good algebraic manipulation skills, were able to reach the printed equation with relative ease. Almost all candidates applied the iteration correctly to gain full marks in part (a)(ii), but in part (a)(iii) only a few candidates realised what was required. These successful candidates evaluated and considered the signs of $\mathrm{p}(3.3825)$ and $\mathrm{p}(3.3835)$, where $\mathrm{p}(x) = 3 + \frac{1}{x} + \frac{1}{x^2} - x$, and showed that there was a change in sign and so concluded that $\alpha$ is $3.383$ correct to three decimal places. A minority of candidates stated the range of $\mathrm{f}^{-1}$ correctly, but a majority of candidates were able to find a correct expression for the inverse function. Part (c), as expected, proved to be a significant challenge to even the more able candidates. Lack of explanation, detail and conclusion were evident in part (c)(i). In part (c)(ii), a significant majority of candidates were awarded the mark for writing the correct expression for $\mathrm{gf}(\sec 2\theta)$, but only a small minority of these were able to provide a convincing proof of the printed result. Again, when asked to prove or show a given result, it is the responsibility of the candidate to convince the examiner. Unfortunately there were many incorrect statements or wrong identities used in solutions which nearly always ended with the 'correct' printed expression.

## Question 14

Although the majority of candidates scored the mark in part (a) for use of the Factor Theorem, it was unfortunate to see other candidates losing the mark because they either failed to show sufficient detail or did not give a concluding statement. The unstructured final part on the paper was a stiff challenge to almost all candidates. However, most candidates gained credit for some correct differentiation of the equation of the curve and more able candidates equated their expression for $\frac{\mathrm{d}y}{\mathrm{d}x}$ to zero and obtained the correct equation $y = x^3$. Some of these candidates then correctly substituted this equation into the equation of the curve to obtain a polynomial equation in $x$, but only a small minority recognised the resulting equation to be a cubic in $x^4$ and correctly factorised it using part (a). Only the most able candidate then gave a valid explanation and proceeded further to score all but one of the remaining marks.

## Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results statistics page of the AQA Website.