Version : 1.1 0107

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Mathematics 6360

MPC4 Pure Core 4

Report on the Examination

2007 examination - January series

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Set and published by the Assessment and Qualifications Alliance.

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General

The full range of marks was seen in the candidates' work, although this was heavily weighted towards the top end. There were many able candidates who demonstrated a thorough knowledge and understanding of the mathematics in the specification, with the quality of the presentation of their answers indicating they were confident in what they were doing. Some of the more able candidates, however, were penalised for poor communication in questions that required them to show that a certain result is true, such as question 3(b)(i). Although such candidates probably can see that the given result has to be true, as a guideline they should show sufficient explanation so that a weaker candidate could follow their argument.

Most candidates made an attempt at all the questions and in the order they were set. It was only the weaker candidates who tended to omit whole questions or parts of questions. The most demanding questions on the paper were question 6(c) and question 8(b)(ii), although most candidates did make an attempt at these.

Question 1

This was the most successful question on the paper with most candidates gaining full marks or close to it. Simple sign and coefficient errors were made in the differentiation, but the vast majority of candidates demonstrated they could use the chain rule correctly. Only a few tried to find y in terms of x first, doing the work actually required for part (c). Some candidates found an equation of the tangent instead of the normal, and a few left t in their final answer. A form of the answer was not specified so any correct form was accepted, but some working with the $y = mx + c$ form sometimes found a value for c, but did not write down an equation as their final answer.

Similarly in part (c) a correct, unsimplified form was accepted for full credit, although it was noted that many did go on to make algebraic errors in attempting to simplify their equation. Most candidates did know what was required for a cartesian equation and many alternative correct versions were seen or a simple sign error was made. A few candidates thought they were required to find the tangent, and some seemed to invent their own equation, such as an ellipse, to substitute into.

Question 2

This question was done well with again many candidates gaining full marks. Some used algebraic division in part (a) for which they gained no credit, although it did give them the answer to part (c). Virtually all those who did use the Remainder Theorem were numerically accurate with their answer. In part (b), those who explicitly used the Factor Theorem with $\mathrm{g}(x)$ gave the clearest explanations. Those who tried to explain the given result without using the Factor Theorem found themselves resorting to the word "must", usually ending with d must be -4, without giving a convincing explanation as to why.

There was also some confusion in notation between f and g for the functions involved. It was anticipated that part (c) would be done by inspection, but the preferred method was algebraic division, usually done accurately. Some candidates multiplied out and equated coefficients, usually correctly, but this method does involve some unnecessary work; $b = -3$ should be immediate.

Question 3

Most candidates just wrote down the required expression for $\cos 2x$, although some worked it out from $\cos^2 x - \sin^2 x$ or $\cos(A + B)$. Omission of the 2 was a relatively rare error. Most candidates were able to derive the result in part (b)(i) although some were penalised for being too brief. Most candidates too were able to solve the resulting quadratic equation, with some making it a little more difficult than intended by reading the 1 on the right hand side as 0. Most candidates found two results for angle x in the required range. Part (c) was less successful: although most candidates understood that they needed the integral in terms of $\cos 2x$, there were many algebraic slips, and sign and coefficient errors in the integral of $\cos 2x$ itself.

Question 4

This question was generally done well with many candidates gaining full marks. Marks tended to be lost in part (a) rather than part (b), possibly because the latter was a more conventional partial fractions problem. There were several different approaches to part (a) including manipulating the numerator to contain $A(x-3)$, algebraic division and cross multiplying and using partial fraction type techniques, or some mix of these. Errors tended to be algebraic or numerical. In part (a)(ii) it was notable that some candidates did not attempt a logarithmic integral, although they went on to do so in part (b).

In part (b) virtually all candidates scored well, either using the expected two values of x or equating coefficients to find the values of P and Q. Again a few made algebraic or numerical errors, with very few cross multiplying incorrectly. Similarly virtually all candidates went on to give some form of logarithmic integrals, sometimes with errors in the coefficients. Very few non-sensible attempts at the integral were seen.

Question 5

It was pleasing to see in both parts (a) and (b) that most candidates were setting out their binomial expansions accurately and clearly. Most were fully correct in part (a). However, in part (b) there were again candidates who did not write down sufficient detail to convince they knew where the given result had come from. The common errors were to take the 8 out as factor and leave it as 8 and then just to divide the ensuing result by 4 to get the answer given, or to ignore the 8 completely. A few candidates used the expansion of $(ax+b)^n$ with $a=8$, which can lead to the correct answer, but needed detail in the numerical evaluation of the coefficients to convince it had been done.

In part (c) most candidates substituted $x=\frac{1}{3}$ as expected and demonstrated the given result. Those few who did make a mistake apparently did not look for it; they just claimed their answer was close to the given $\frac{599}{288}$. Those few candidates who did not show where this fraction came from, but used a calculator to show it was approximately $\sqrt[3]{9}$, gained no credit.

Question 6

In part (a) most candidates did attempt to find $\overrightarrow{BA}$ although some did the calculation for $\overrightarrow{AB}$, and despite being asked for $\overrightarrow{BA}$ in part (a)(i) many candidates proceeded to do the scalar product in (a)(ii) using $\overrightarrow{AB}\bullet\overrightarrow{BC}$. Such candidates often slipped a minus sign into their final answer rather than look for an error, either unexplained or with a comment like "it's the other angle". Some candidates used the position vectors, some finding a scalar product and multiplying the magnitudes of all three of $\overrightarrow{OA}$, $\overrightarrow{OB}$ and $\overrightarrow{OC}$. A few candidates used the cosine rule, which is a valid method, but the attempts tended to be error prone.

Part (b) was generally done well, although the amount of explanation offered varied considerably. Those who solved one component equation for $\lambda = 3$ needed to verify it in both the other equations. Those who just saw that $\lambda = 3$ needed to demonstrate that this did give vector $\overrightarrow{OC}$ (many did), or the equivalent form of $3\begin{bmatrix}1\\3\\-2\end{bmatrix}=\begin{bmatrix}3\\9\\-6\end{bmatrix}$. In part (b)(ii) a comment was expected to accompany $\lambda = 2$ or $\lambda = -2$, the latter being accepted, about the direction vectors being the same or, as a minimum, just stating this shows they are parallel. Simply stating the direction vectors are the same without showing it was not accepted.

There were several approaches that could be made to the problem in part (c). The correct answer can just be written down and some candidates did this, it coming from $\overrightarrow{OA}+\overrightarrow{BC}$. Very few candidates drew a diagram or made use of previous parts of the question, which is perhaps why many sign errors were made in the directions of the vectors, and correct directions are essential to this problem.

The coordinates of D as $(13,\ 12,\ -8)$ was a common wrong answer. Although it lies on line l, it does not give AD as parallel to BC. Some candidates attempted to use intersecting lines, which does lead to the correct answer, although many candidates made an error in their algebra. Another possibility used by some candidates was to equate the lengths of the sides of the parallelogram. Some candidates, who had achieved highly on the rest of the paper, pursued their ideas here relentlessly, rather than stopping and rethinking the problem after a couple of sides of working in which they had made an error.

Question 7

This question proved to be more straightforward than anticipated, with many candidates gaining full marks from a well-presented answer. Most candidates could do part (a), although a few did not simplify their answer, although they were not required to. However $\tan 2x$ expressed as $\tan(2+x)$ was seen a few times. In part (b) most candidates took the anticipated route of substituting for $\tan 2x$, and then convincingly dealt with the resulting algebraic fraction. Some then made a sign error in their simplification. Some manipulated the expression for $\tan 2x$ into an expression for $\tan^2 x$ and then substituted that into the expanded form of $(1-\tan x)^2$. Some did this correctly, but others got bogged down due to algebraic errors and often abandoned their attempt.

Question 8

The responses to this question were very mixed, varying from the very poor to some excellent answers. Most, but not all, candidates did attempt to separate and integrate in part (a)(i) with some making an error in their integrals, and rather more omitting a constant. Such candidates could make no further progress in part (a)(ii) without a constant to find. Some candidates thought to bring e^{-1} into their answer in part (a)(i), instead of the expected conventional constant, and got themselves confused in part (a)(ii) as they could not convincingly obtain the given answer. Some candidates made the anticipated error at the exponentiation stage of $\ln y = -\cos t + c \Rightarrow y = e^{-\cos t} + e^{c}$. Many candidates could not justify the 50, other than saying it was the initial value.

For part (b) many candidates realised they had been given the required expression in part (a) and substituted and evaluated correctly, although some ignored the request to answer to the nearest centimetre, any greater accuracy being rather meaningless in this modelling problem. Some used degrees instead of radians. Other candidates substituted into the differential equation. In part (b)(ii), although most candidates knew in principle what to do, they could not find the second derivative correctly. Many treated y as a constant or as if it were t, rather than using implicit differentiation.

Some candidates did attempt to differentiate the given answer in part (a)(ii) twice, but usually made an error in their use of the chain rule. Some candidates did get the differentiation correct, but failed to complete their argument by demonstrating that the first derivative was zero at $t = \pi$, so confirming this point as a turning point.

Mark Ranges and Award of Grades

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