Version 1.0

General Certificate of Education (A-level)
January 2012

Mathematics MPC4

(Specification 6360)

Pure Core 4

Report on the Examination

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales (company number 3644723) and a registered charity (registered charity number 1073334).
Registered address: AQA, Devas Street, Manchester M15 6EX.

General

A full range of marks was seen. Most candidates attempted all the questions, with occasionally question 7 and/or question 8 being omitted. Otherwise, there was little evidence of candidates having insufficient time.

The question that was done the best was the binomial expansion question, question 3. Questions 4 and 5 were also done well. The last part of the vectors question, question 8, was a demanding challenge and there were relatively few successful outcomes. Similarly, the last parts of questions 1 and 6 defeated many candidates. Candidates generally presented their solutions well, with clear working shown and appropriate justification given where it was needed.

Question 1

In part (a), virtually all candidates showed confidence with finding the partial fractions and, bar a few slips, had this correct. Using two values of x to find A and B was by far the most popular method, although some candidates set up and solved simultaneous equations.

For part (b), there are several ways of finding the coefficients C and D, and these were all seen in candidates' work. The anticipated method of long division was seen less often than multiplying through by the denominator and then using two values of x or equating coefficients of powers of x or a mix of the two. Those who used long division sometimes failed to interpret their result. Using $x = 0$ readily gives the value of D, but those who used $x = \frac{3}{2}$ in finding C often made a mistake; the value of C is most readily found by equating the coefficients of x^3. Those candidates who did not use an efficient method here would have wasted time that may have been more gainfully used in other questions.

A significant minority failed to make any progress in part (c) through not seeing the connection to parts (a) and (b). Most immediately went for an incorrect logarithmic integral and scored no further marks. Those who did attempt to use the results from parts (a) and (b) often made sign and/or coefficient errors during the integration. Some candidates who otherwise had this part all correct, failed to score the last mark because they made an error in attempting to manipulate their logarithms to the required form.

Question 2

Most candidates had part (a)(i) correct, although the amount of work they did varied considerably. Some just wrote down the value of $\tan\alpha$, presumably recognising the 3-4-5 triangle, whereas others used Pythagoras. Several weaker candidates divided $\sin\beta$ by $\cos\alpha$ to give an answer of $\frac{5}{6}$. Some candidates used trigonometric identities, some finding $\sin\alpha$ first and using it together with the given cosine to calculate the tangent.

In part (a)(ii), the majority of candidates failed to work with a negative value for $\tan\beta$, despite most of them showing awareness of an obtuse angle through quoting $150°$. These candidates then could not get to the right answer in part (b).

However, in part (b), most candidates did use the compound angle formula for $\tan(\alpha+\beta)$ correctly, with only a few sign errors seen and some leaving the $\pm$, from the formula book, in their expression. Most tried to manipulate the surds in their expression towards the required form of the answer, but with varying degrees of success. Those who inverted the denominator and then multiplied the resulting fractions were the more successful. Some who had worked with the correct value of $\tan\beta$ failed to get to the required form by not seeing that they could cancel or multiply through their expression by a factor of $\sqrt{3}$.

Question 3

Most candidates had part (a) correct, although some made an arithmetic or sign error, most commonly in the x^2 term.

In part (b), most candidates showed they knew the conventional starting point of factoring out the 8, and did this correctly, with relatively few losing the $\frac{2}{3}$ power on the 8 or not having $\frac{6}{8}$ or $\frac{3}{4}$ as the coefficient of x. Some made arithmetic slips, particularly in the x^2 term. Others got to a correct binomial expansion in spite of omitting some brackets from their working; this was condoned on this occasion.

In part (c), the common mistake was for candidates to equate $8+6x$ to 100, rather than to 10, and to work with $x=\frac{46}{3}$, apparently not noticing that this gives a negative number as a result. However, a significant minority of candidates were able to see, or work out, that the value of x they needed was $\frac{1}{3}$ and completed the question successfully.

Question 4

Most candidates demonstrated some understanding of the information given in this in-context question on exponential growth and decay. There were many fully correct solutions.

Most candidates had part (a) correct, with relatively few either not converting 1 hour to 60 minutes or failing to round correctly to the nearest 1000, or not rounding at all.

In part (b)(i), most candidates set up the correct starting-point equation, but they were required to manipulate it to a point where logarithms could be taken before marks were awarded; many failed to do this. Knowledge of using logarithms varied widely. Many were unable to deal properly with the coefficient and the exponential term and wrote down equations in which t actually should have cancelled out. However, many candidates managed to reach a 'solution' from such incorrect working. In contrast, many other candidates gave a concise derivation of the correct answer.

In part (b)(ii), again many candidates set up the correct starting equation, or something close to it, and some used inequalities, which were accepted. Although many did show clearly how the given equation was derived, others could not handle the exponential terms correctly or made sign errors in manipulating their equation. However, many of those who could not derive the quadratic equation in $e^{\frac{1}{8}T}$ did recognise it as such and solved it successfully.

Pleasingly, most candidates also rejected the $e^{\frac{1}{8}T}=-10$ as impossible. Relatively few tried to find a solution again via taking logarithms immediately, but those who did made no progress and abandoned the question.

Question 5

Most of the candidates had part (a) correct, with the majority choosing to substitute $t=\dfrac{3}{y}$ into the given equation for x rather than to substitute into the given cartesian equation. The commonest, but rarely seen, error was to not square the 3 or to make a sign error.

The majority of candidates chose to approach part (b)(i) through parametric differentiation, and most did it accurately, with many gaining full marks. The most common error was to lose the minus sign on the -16 gradient, having initially found this correctly. Others made mistakes with the fractions.

For part (b)(ii), there are numerous ways in which this intersection can be verified, and many different ways were attempted by the candidates. Many scored 1 mark by finding the y-value, either directly from their tangent or from the curve, or even via the parametric equations.

Some substituted their tangent equation into the curve and attempted to verify that $x = \frac{3}{2}$ satisfied the equation. Some did this convincingly, but others proceeded rather more in hope than expectation. Some tried to factorise the resulting cubic equation. The most efficient method was to find the y-value from the equation of the tangent and then verify that $\left(\frac{3}{2}, -8\right)$ satisfies the equation of the curve. This method was mostly seen from those who achieved full marks on the question.

Question 6

In part (a), virtually all candidates knew that they were to substitute $x = \frac{3}{4}$ into the cubic expression, but many either failed to show any detail of a calculation leading to zero and/or failed to give a conclusion as to the significance of such a result. Candidates need to recognise that when a printed answer is given, as with $(4x-3)$ being a factor here, they need to give a full justification of why this is the case.

In part (b), most candidates showed that they were familiar with the double angle formulae, but more so the double sine formula, with there often being an error in that of the double cosine. However, many substituted correctly, and manipulated their expression in θ correctly using $\sin^2\theta = 1-\cos^2\theta$, before converting to x. Some substituted x for $\cos\theta$ as soon as they could and sometimes got into a confused expression which they were unable to deal with convincingly. Some candidates tried to approach the problem by working on the sine and cosine parts separately; sometimes they were successful but again some became confused when they tried to put it back together in terms of x. Some candidates failed to secure the final mark by not equating to zero.

Most candidates attempted part (c) and knew that they were to factorise the cubic expression. Some used long division by the given factor of $(4x-3)$ but then did nothing with their resulting quadratic expression, whereas others showed the correct interpretation and wrote down the factorised form of the cubic expression. Some candidates factorised the cubic expression by inspection, mostly correctly, but with the occasional error in the x-term of the quadratic factor. Some candidates who had a correct factorisation failed to score the last two marks as they simply said that the quadratic did not factorise or that it had no roots, without demonstrating why. To score the marks, candidates were required to calculate their discriminant and, if correct, note that it was negative and thus that there were no more (real) solutions to the cubic equation. Most of those who did this concluded the question with a convincing argument as to why there was only one solution to the cubic equation and thus to the trigonometric equation and stated the real solution.

Question 7

A substantial proportion of candidates solved this differential equation successfully, which is an impressive achievement given that there is a considerable amount of careful manipulation involved. Most candidates started with a correct separation, with most of these using correct notation. Many integrated $\frac{1}{y^2}$ correctly, but this was not the case with the integration of $x\sin 3x$. Some showed no detail of an attempt at parts and scored no further marks. Of those who did show stages in their parts integration, some made sign and/or coefficient errors. Most candidates knew that they were to include a constant and attempted to find it, but they needed to have a $\cos 3x$ and a $\sin 3x$ term in their expression to demonstrate knowledge of $\sin\frac{\pi}{2} = 1$ and $\cos\frac{\pi}{2} = 0$ when finding the value of the constant. The final stage of factoring out a 9 and inverting was done successfully by most who had got this far, although some incorrectly added the constant after inverting and scored no further marks. Those who failed to gain the last mark usually made an error in their last line or two of working, making a sign error or dropping a 3 or even the x.

Question 8

Well over half of the candidates scored the first 6 marks, showing knowledge and competence in finding a vector from coordinates and using the appropriate vectors to find an angle between a vector and a line.

In part (a)(i), most candidates showed they knew how to find the vector $\overrightarrow{AB}$, with relatively few doing the subtraction the wrong way round. Some candidates made arithmetic slips.

In part (a)(ii), virtually all candidates showed that they knew how to use a scalar product to find an angle between two vectors, but some candidates chose the position vectors of points A and B rather than vector $\overrightarrow{AB}$ and the direction vector of the line; they could score one mark if they used the formula correctly. A few equated to the sine rather than the cosine of the angle. Some candidates dropped a sign when copying the vector $\overrightarrow{AB}$, so the scalar product then often became zero; these candidates correctly interpreted this result as $90°$, and gained a 1 mark credit for this. Many candidates, however, went on to get the right answer. Many unnecessarily manipulated their expression for the cosine using surds before finally doing the appropriate calculation on their calculator.

The key to success in a question such as this part (b) is to draw a diagram to aid geometrical thinking. Relatively few candidates did so, and of those that did some had the given right angle in the wrong place. To progress further, candidates needed to find the vector $\overrightarrow{BC}$ in parametric form and use it in a scalar product with vector $\overrightarrow{AB}$ in order to find the value of the parameter that leads to the result. Those who did not do this could score no further marks.

Of those candidates who showed they knew in principle what to do, many made an error in their arithmetic so could not get to a correct result for the parameter. It so happened that many candidates used vector $\overrightarrow{OC}$ rather than $\overrightarrow{BC}$, made an error and got what appeared to be the right value for the parameter and then completed to get the right answer; however they were given no credit. Some candidates, who got as far as successfully finding the coordinates of point C, could not see how to use the geometry of the rectangle to find the coordinates of D. Some went back into parameters and scalar products, whilst others tried to equate the lengths of the sides, all to no avail. Relatively few achieved full marks on this question.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results statistics page of the AQA Website. UMS conversion calculator www.aqa.org.uk/umsconversion