General Certificate of Education

Mathematics 6360

MPC4 Pure Core 4

Report on the Examination

2010 Examination – January series

Further copies of this Report are available to download from the AQA Website: www.aqa.org.uk

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 *Dr Michael Cresswell Director General.*

General

Most candidates attempted all the questions in the order as set on the paper; only a few candidates omitted any questions. A full range of marks was seen, from some very impressive scripts with well presented mathematics to those where the candidate seemed to be ill prepared for the examination and showed little knowledge of the specification.

Candidates in general scored well on questions 1 and 4, and in parts (a) and (b) of questions 8 and 9. However, the latter parts of these questions were found demanding, and in general question 6 was not answered well. Presentation in general was good, with candidates showing clear working to support their answers, but some who deleted work did rather over exaggerate their crossing out.

Question 1

Virtually all candidates had part (a)(i) correct, with only a few making an arithmetic error. Some wrote down the implication that $(x+1)$ was a factor of $\mathrm{f}(x)$, which helped in part (b).

In part (a)(ii), most candidates evaluated $\mathrm{f}\left(\frac{2}{5}\right)$ correctly, but many lost the accuracy mark either through not giving an explicit conclusion or for showing insufficient working to justify $\mathrm{f}\left(\frac{2}{5}\right)=0$. Some candidates chose to use algebraic division which was an acceptable method, but still required the conclusion to be drawn from a zero remainder.

In part (b), some candidates factorised by inspection using the results from part (a) and completed the question very efficiently. Others proceeded by long division and factorisation of the resulting quadratic expression to find other factors, and a few used $(ax+b)$ and determination of coefficients. Most candidates obtained the correct answer, with a great variety in the amount of working done, but a few went beyond this and were penalised for incorrect further cancelling. Some candidates thought they were required to express the answer in partial fractions.

Question 2

In part (a), most candidates were able to find R and α correctly, with only a few arithmetic errors seen. Some candidates made the error of using $\tan\alpha=\frac{1}{3}$, or equivalent, although most candidates did use the tangent to find the value of α. Some ignored the request for three decimal places, but two decimal place accuracy was condoned.

Many candidates obtained a correct answer to part (b), although some did not give the minus sign on $\sqrt{10}$, or thought 0 or -1 was the minimum value. There was confusion among some of the candidates between the minimum value and the value of x at which it occurred, although again many correct answers were seen, but here too not always to three decimal place accuracy.

In part (c), candidates who realised that they were to use part (a) usually made some progress. Those relatively few candidates who did not realise this usually tried to square the equation, but many did not realise this could only be successful if the $\sin$ or $\cos$ term was moved to the other side first. Many such attempts were abandoned. Those who used the expected method often lost 1 or 2 marks, through not giving all possible solutions in the range, and in particular the last accuracy mark was often lost as candidates did not make use of -0.886 in their working. Three decimal place accuracy was required for the final mark as were answers in radians: degrees were condoned during the working and in part (b) but not in part (a).

Question 3

In part (a)(i), most candidates had the binomial expansion correct with some making an error in the x^2 term, with often the 2 being a 1.

Most candidates also had the expansion in part (a)(ii) correct. Most used the method of replacing x with $\frac{3}{4}x$, whilst some started the expansion again. The common error was again in the x^2 term, where the coefficient $\frac{3}{4}$ had not been squared.

In part (b), although some very neat, correct solutions were seen, most candidates could not handle the indices, although most knew they were to manipulate the expression to use the result from part (a)(ii). There were many errors in attempting to handle the indices $\pm\frac{1}{3}$. A few candidates who had handled the manipulation correctly, decided to double their final answer for no apparent reason.

Question 4

In part (a), most candidates knew to multiply through by the denominator and many did this correctly and went on to find A and B successfully. However, some candidates did not apparently know how to handle the 2, some omitting it altogether and some including it but not multiplying it by the denominator. Some candidates multiplied out the denominator and divided by the resulting quadratic expression to separate out the 2, then worked with the resulting algebraic fraction. Although this was unnecessary, it was a perfectly acceptable method. Relatively few candidates used the method of setting up simultaneous equations to find A and B.

In part (b), virtually all candidates knew they were to use the partial fractions to do the integration, and most recognised that log integrals were involved. The common error was to miss the multiplier $\frac{1}{5}$ when integrating $(5x-1)^{-1}$. Several candidates inverted the coefficient, giving it as $\frac{5}{7}$. Although most candidates integrated 2 to $2x$, many omitted the arbitrary constant.

Question 5

There were many correct answers to this question, although the amount of working shown varied considerably; some, for example, went into u and v for the product whilst others just wrote all the derivatives down. Those who had the derivatives all correct usually went on to calculate the gradient correctly, although mistakes were seen in handling $e^0 - -1$. The common error in the differentiation was in the e^y term where the $\frac{dy}{dx}$ was not attached or it became ye^y or similar. Some candidates differentiated the expression with respect to y, and inverted the result for the gradient, which was both perceptive and, of course, acceptable. Some candidates thought they should take logs of both sides first, and often went on to create nonsense, although those who had recognisable derivatives in an attempt at the chain rule could gain partial credit.

Question 6

In part (a)(i), most candidates stated the formula for $\sin 2\theta$ correctly although not always in its simplest form.

In part (a)(ii), although many candidates knew the formula for $\cos 2\theta$ in at least one its correct forms, several gave $\cos^2\theta + \sin^2\theta$, and later in the question just gave the value of $\cos 2\theta$ as 1 without apparently thinking something could be wrong.

In part (a)(ii), many candidates had problems. It appeared that the 3-4-5 triangle was either not well known or not recognised as relevant; although some candidates did draw this to justify their answer others used $\sin^2\theta = 1 - \cos^2\theta$. Many candidates worked backwards from the answer given, to find a value for $\sin\theta$, which gained no credit nor did going via an angle from the given value of $\cos\theta$. Many candidates omitted to find $\cos 2\theta$ or, as above, gave the value as 1, or another incorrect value from an incorrect expression. Those who did find the correct value for $\cos 2\theta$ often dropped the minus sign in later working.

In part (b)(i), the use of the chain rule with these parametric equations was generally done well with most candidates completing it correctly. Some candidates apparently tried to integrate rather than differentiate and some made sign errors when differentiating. A few candidates had the chain rule expression the wrong way up.

In part (b)(ii), although some neat and concise correct answers were seen, many candidates got in a mess trying to use angles and not working in exact fractions. Some confused the value of the sine and cosines involved with the angles writing terms such $\sin\frac{3}{5}$. Some left a mix of fractions and decimal numbers in their final answer, which is bad practice but was accepted if the values of the coordinates at P were correct.

Question 7

Marks for this question covered the whole range from 0 to 6. Many candidates knew the topic well and gave a concise and correct solution for full marks. Most candidates separated the variables correctly with conventional notation, the common error being to have $\frac{1}{y}$ on the left hand side followed by a log integral; there were also many errors in integrating $\cos\left(\frac{x}{3}\right)$.

Although most candidates knew this involved sine, there were errors with signs and the coefficient was often given as $\frac{1}{3}$ rather than 3. Some candidates dropped the 3 completely.

Candidates who had only made sign or coefficient errors could gain partial credit when finding a constant of integration and many did. Pleasingly, virtually all candidates who attempted this worked in radians. Some candidates omitted the constant altogether and substituted the given values into their solution, or even the given differential equation to produce nonsense. Some candidates confused themselves by multiplying by 2 before finding the value of their constant and then halved it again at the end.

Question 8

Most candidates answered part (a) well using a variety of methods. Virtually all gave the value of λ as -2, either explicitly or implied by its use, and then completed a full justification. A common error was to verify only one of the two other coordinates, or use poor notation that was not convincing.

In part (b), apart from the occasional arithmetic error, all candidates found the vector correctly.

In part (c)(i), most candidates went on to use the result from part (b) correctly to find the coordinates of D, although most left the result as a vector rather than in coordinates. Many candidates, though, used poor notation with, for example, *D* representing the vector $\overrightarrow{OD}$.

The key to success in part (c)(ii) was in noting that the scalar product between $\overrightarrow{PD}$ and the direction vector of the given line was zero. Although some clear and correct answers were seen, this part defeated many candidates, although some might have gained some credit had they been clear which vectors they were trying to work with. Many candidates did not attempt to express the vector $\overrightarrow{PD}$ in terms of λ and so could make little progress. Similarly, those candidates who let the point P have coordinates (x, y, z) were unsuccessful often abandoning a complex looking algebraic expression. Those who made some progress tried to take the scalar product with a point on the line rather than its direction, and produced largely insoluble equations, which were abandoned, or a value of p just appeared. Some candidates who clearly understood what they were doing made sign or coefficient errors when finding $\overrightarrow{PD}$; a common wrong answer was $p = -6$.

Question 9

Most candidates answered part (a)(i) correctly, although a surprising number seemed to think that $A \times 0 = A$.

Most candidates did part (a)(ii) convincingly, usually choosing to evaluate the exponential expression as $0.95\ \ldots$ and solving for A to demonstrate its value is 60 to two significant figures. Those who did not actually solve for A or did not show A as $59.9\ldots$were penalised.

Most candidates started part (b)(i) well, showing they had interpreted the information given correctly. However many could not manipulate their resulting $\ln$ expression into the form required; many, either not knowing what was meant by "a and b are integers" or not taking notice of it, left their result in fractions. Many candidates 'lost' a minus sign during their working whilst some attempted to take the $\ln$ of a negative number.

In part (b)(ii), a few candidates were able to derive the result clearly and efficiently; others managed it after some working that was somewhat difficult to follow whilst others made an error such as dropping a minus sign but still claimed they had obtained the result. However, many candidates gave up after finding $\frac{\mathrm{d}h}{\mathrm{d}t}$. A few candidates attempted to integrate the given differential equation, some successfully recovering the given expression for A, which was both acceptable and impressive.

Although many candidates had part (b)(iii) correct, many errors were also seen, quite a common one being $4 \times 2 = \frac{1}{2}$. The other common error was to substitute $h = 13$, rather than $\frac{\mathrm{d}h}{\mathrm{d}t} = 13$. It was notable that many candidates attempted part (b)(iii) before returning to try and sort out part (b)(ii), which was sensible.

Mark Ranges and Award of Grades

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