A-LEVEL
MATHEMATICS

MPC4 - Pure Core 4
Report on the Examination

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General

Most candidates made an attempt at answering all the questions and a full range of marks was seen. There were relatively few very poor scripts, and most candidates were able to demonstrate at least some knowledge and understanding of the specification. There were also some very good scripts where candidates demonstrated considerable mathematical ability. Presentation of solutions was generally good with candidates making it clear which part of a question they were answering and keeping their answers in the spaces provided for each question. Some made use of an additional sheet if they ran out of room or wished to replace an answer. There was little evidence of candidates misreading signs or coefficients from the questions or of miscopying their own work.
The first parts of questions 1 to 5 were generally done well, with relatively fewer candidates being able to answer the last parts of these questions successfully. Question 7 was done well, but the response to the question 6, the vectors question, and question 8, involving differential equations, was very mixed.

Question 1

Part (a). The vast majority of candidates showed they are confident in finding partial fractions and answered this question correctly with only the occasional error being seen. Most substituted appropriate values of x, with few using simultaneous equations, although some candidates used a mix of the two methods.

Part (b). The vast majority of candidates recognised that these were logarithmic integrals but many made sign errors in the coefficients and/or the multiplying constants. Most were able to show the evaluation of the definite integral although it wasn't always clear what they were doing, some making poor use of brackets and others trying to take short cuts. However, many did evaluate successfully and knew that $\ln 1 = 0$. Some candidates lost the final mark because they could not manipulate the logarithms correctly or simply made an error in the arithmetic with the fractions.

Question 2

Part (a). Most candidates were able to derive the correct expression with most finding R correctly as $\sqrt{29}$, although some used a decimal approximation or another error. In finding α some just used $\tan\alpha = \frac{5}{2}$ with no other working being seen although occasionally the fraction was upside down. Often a full expansion of $R\cos(x+\alpha)$ was used, with some candidates making sign errors here. Those who used $\sin\alpha = 5$ or $\cos\alpha = 2$ were penalised for an incorrect method.

Part(b)(i) There was evidence here of candidates not reading the question carefully. Some actually gave the maximum value which didn't matter but gained no credit, whereas some answered the question as if it had been about the minimum value. Many gave a correct solution for where a maximum value lay but outside of the requested range, not realising the need to subtract from 2π. Most responded correctly to the request for an answer to three significant figures.

Part (b)(ii) This was rather more successful than part (i) with most candidates clearly trying to use their result from part (a) and setting up an appropriate equation. Many though made errors in attempting to solve their equation, some missing one of the two solutions in the range, or just simply getting the solution wrong. Some candidates, who had correct solutions, did not respond correctly here to the request for answers to three significant figures.

Question 3

Part(a). The vast majority of candidates responded positively in showing use of the remainder theorem and attempting to solve $\mathrm{f}(-\frac{1}{2}) = -2$ for d. Those few who used long division were penalised. There were some errors made in the evaluation of $\mathrm{f}(-\frac{1}{2})$.
Part(b) (i). The vast majority of candidates were able to factorise this cubic expression correctly, most making use of long division and factorising the resulting quadratic expression with just the occasional error seen.
Part(b)(ii). Similarly here, most simplified the algebraic fraction through factorising and cancelling correctly, but very few were able to convincingly explain why $\mathrm{h}(x)$ is a decreasing function through knowing that this required differentiating the function. Most just substituted a few values and noted that $\mathrm{h}(x)$ got smaller, or argued $\mathrm{h}(x)$ approached zero as x increased or similar inadequate explanations. Of those who did differentiate correctly, some were still unable to make a general statement about the derivative always being negative, but thought it sufficient to demonstrate this with one or two particular values of x.

Question 4

Part(a). Most candidates were successful with some just writing the expansion down correctly with little or no working seen, whilst others wrote out a fuller expansion before simplifying. Few errors were seen.
Part(b)(i). This binomial expansion was also done very well, with the vast majority of candidates taking out the 8 to the correct power and expanding the resulting expression correctly, most taking care with the coefficients and brackets; although some did make errors here or in the simplification of their expansion.
Par(b)(ii). Relatively few candidates were able to derive the required $x = \frac{1}{3}$ to answer this question correctly, with some making no attempt at all and others making errors in manipulation of the indices and ultimately getting a result that they should have seen could not be correct. Some just wrote down a calculator result for the required root, which gained no credit as it did not answer the question.

Question 5

Part(a). This was answered very well, with most candidates using parametric differentiation correctly, and substituting correctly to get the expected answer for the gradient. There was just the occasional error in the differentiation including the few who dropped the 2 from $\cos 2t$.
Part(b). This too was answered very well, with virtually all showing knowledge of $m_N = -\frac{1}{m_T}$ although a few answered this question for the tangent and not the normal, and gained no credit. Most went on to set up the equation for the normal correctly, and gave their answer in the requested $y = mx + c$ form. Some did make an error here in manipulating the fractions and signs.

Part(c). The response was very mixed, with some candidates not understanding the question, and continuing to use an equation in x and y rather than substituting for them at the given point. Some did manage to correct this later by use of their normal equation. Most knew, or derived, the required identity for $\cos 2q$ but relatively few were able to use this to set up a correct quadratic equation; a three term equation was expected for the mark and subsequent solution. Most candidates did know they were to work in q rather than t . Of those who got a quadratic equation, many didn't solve it correctly making errors in both attempting to factorise or in use of the formula. Of those who got the correct roots of $\frac{1}{2}$ and $-\frac{3}{4}$ many showed confusion, with some saying $\sin q = -\frac{3}{4}$ was impossible, or some thinking $-\frac{3}{4}$ was the required x coordinate. Few fully correct solutions were seen.
Hardly any candidates attempted Question 5 using a Cartesian equation, but some did bring this approach into part (c). However, having set up a correct equation and differentiated it, most proceeded to set up a quadratic equation in x $(\cos 2q)$ rather than y $(\sin q)$ and got no further credit. Although it is possible to solve the problem this way, hardly any candidates did.

Question 6

It was evident in this question that many candidates do not know the difference between a position vector and a direction vector. Most candidates made some attempt at part(a), less so for part(b) and many made no attempt at part(c).
Part(a). Most candidates showed they knew the appropriate formula to use, although some just attempted to find vector AB then apparently didn't know what to do with it. There were many fully correct answers, but candidates made a number of errors including those who chose to use the position vectors of points A and B, and gained no credit. Errors were made in signs when copying vectors and in the arithmetic of the scalar product and/or the magnitude of vectors.
Part(b). Many candidates showed that they are familiar with the technique required here, and carried it out successfully, whilst others made sign or coefficient errors in the vectors and thus got an incorrect value for parameter λ and thus the coordinates of point *C*. Those who worked with a point (x, y, z) for point *C* gained no credit until they converted to a parametric form.
Part (c). Of those candidates who attempted this question relatively few concise and correct answers were seen. Those who drew a diagram identifying where the points E are located were generally more successful. Most candidates adopted a poor problem solving strategy; the problem can be solved in a few lines using parallel vectors that are equal in magnitude but few spotted this. The majority tried to solve the problem setting up equations of lines and using magnitudes of vectors but usually abandoning the attempt. The problem can be done this way, but it involves setting up a quadratic equation and solving it, and many made errors in the attempt to do so, creating some very unfriendly looking numbers in the process.

Question 7

Part(a). Most candidates responded to the request to *show that*, and showed the term by term results of substituting into the equation before simplifying. Those who just wrote an answer down for k gained no credit. There were relatively few mistakes, but the common ones included errors in evaluating the exponential term, or in the arithmetic of the resulting fractions.

Part(b). Most candidates showed they were competent with implicit differentiation and many fully correct solutions were seen. The common error was either to omit the derivative of the constant as 0 and so not have an equation, or to 'differentiate' the $\ln$ part of the constant. A less common error was where candidates displayed no knowledge of the product rule. Most candidates attempted to find an explicit expression for the derivative, which was unnecessary as the coordinates of point P can be substitute directly into the expression, and then a value for the derivative found. Many made an algebraic error in their manipulation, dropping the y term from the product being common. Errors were also made in evaluating an algebraically correct expression for the derivative at point P.

Question 8

There was evidence of candidates not reading the question carefully in both parts of this question.

Part(a). Many candidates made little successful progress, often not being able to write down a separation of the variables in the correct notation. The 5 in $\frac{1}{5}$ seemed to cause some candidates difficulties with many writing $\frac{1}{5(1+t)^2}$ as $5(1+t)^{-2}$ or something similar somewhere in their solution. Of those who separated the algebraic terms correctly, the integral of $\frac{1}{\sqrt{4+5x}}$, usually written as $(4+5x)^{-\frac{1}{2}}$ was at least partially correct, with a correct power but an error in the coefficient. The integration of $(1+t)^{-2}$ was often less successful, with some seeing this as a ln integral, and others expanding $(1+t)^2$ and integrating term by term in the denominator. Most candidates included a constant, $+C$, in their solution, but few attempted to find it, although the information needed was in the text of the question. Many candidates who had the integration correct didn't find a value for C, although many of these did manipulate their expression to get an explicit equation for x correctly. Some made errors in their manipulation, the common ones being in multiplying through by a coefficient incorrectly or to square each term rather than the whole expression on the right hand side. Relatively few fully correct solutions were seen.

Part(b)(i). Not all candidates attempted this question, but of those who did the vast majority started correctly with the expected $\frac{dr}{dt}$. Although many correct differential equations were seen, many candidates did not respond correctly to 'inversely proportional' and/or gave their differential equation in terms of A the area of the circle, rather than its radius r. Some candidates showed little or no understanding of the information given, often bringing a spurious t into their equation, and often as an exponent. As such they couldn't score marks in part(b)(ii) as there was no information about time, but such candidates didn't realise this and just seemed to make something up.

Part(b)(ii). Those candidates who had a correct differential equation in part (b)(i) usually completed this successfully. Those who had used direct proportionality gained credit for finding their constant even if they couldn't get the right answer. There had to be a constant of proportionality to find and no t in the expression for candidates to score the method mark here. Most candidates did not apparently notice the change of unit, but this did not matter as the unit conversion is absorbed into the constant, but some who tried to change units didn't seem to realise this, resulting in an error.

Mark Ranges and Award of Grades

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

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UMS conversion calculator