AQA

A-LEVEL
MATHEMATICS

MPC4 Pure Core 4
Report on the Examination

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General

The paper provided most of the students with the opportunity to demonstrate their mathematical knowledge. The structured format of many questions helped the majority of them to develop successful arguments, though the greater complexity of the later questions proved more demanding for the less able student.

There were relatively few poor scripts and a fair proportion of students demonstrated considerable knowledge of the specification. In general the presentation of scripts was good, though many students often needed multiple attempts at a solution. As in previous years, many students resorted to the use of additional stationary when sufficient room existed within the assigned answer booklet space.

Question 1

This was in general a good start for most students, and many completely correct solutions were seen.

(a) Students were often able to find the relevant parametric derivatives and to use them to find the appropriate form for $\frac{dy}{dx}$ in terms of the parameter t. Pleasingly, most students were able to differentiate $(t-1)^3$ without needing to multiply out first, although more had problems when differentiating the t^{-2} term. A few students divided the derivatives of x and y the wrong way round, and a very few tried to obtain the Cartesian equation before differentiating. Of the few that adopted this approach, none of them reintroduced the parameter t and they hence failed to answer the question.

(b) Having obtained an expression for $\frac{dy}{dx}$, most knew how to obtain the equation of the normal, though a number compounded errors from part (a) either by not being able to obtain the correct coordinates of the point on the curve where $t = 2$ or by not giving their final answer in the given form. Perhaps more disappointingly, a number of them simply found the equation of the tangent.

Question 2

(a) This question also proved a good source of marks with many of the students being well trained in this trigonometric procedure. All but a few managed to get the value of R correct with almost as many getting the correct value of α. The two most common errors when trying to find α were to divide the expressions for $\sin\alpha$ and $\cos\alpha$ the wrong way round or to express the equations for them without including R, leading to $\sin\alpha = 3$ and $\cos\alpha = 7$. Although these often led to $\tan\alpha = \frac{3}{7}$, these students were penalised as a result of their incorrect working.

(b) Again there were many fully correct solutions to this part though a number of students failed to find the second solution or included solutions in incorrect quadrants. Pleasingly very few failed to give the solutions to the required accuracy. Attempts by alternative methods were even rarer.

Question 3

This question also proved a good source of marks to many students.

(a)(i) Almost all of the students used the correct value of x in the Factor Theorem and many of them gained both marks. There was still a good proportion, however, who failed to show sufficient working or state an appropriate conclusion, thereby losing the second mark. Only a very small minority used the process of long division to show that there was no remainder. These scored no marks as they had failed to answer the question that they had been given.

(a)(ii) Most students were able to find the correct quadratic factor and many went on to attempt to show that this quadratic had no further linear factors, albeit with varying degrees of success. Some use of the discriminant was expected and simply saying "it has no linear factors" was not sufficient to complete the solution nor was simply trying a handful of 'possible' factors.

(b) Almost all of the students opted to find the full cubic and then successfully found the correct linear factors. Although most used the given linear factor of $(3x + 2)$, there were some who searched for a different linear factor first, usually $(x – 2)$, in order to complete the factorisation.

(c) Those who were successful with part (b) usually dealt with this part efficiently, picking up both marks. However there were some who were unable to fully factorise the denominator, with the factor x often lost or ignored, and there were a few who, having reached the stage of $\frac{x-2}{x}$, could not then produce the specified form.

Question 4

Students have clearly been well taught in this topic, though part (c) did cause some problems.

(a) There were a few occasions when the sign of the x term was incorrect, or the tidying up of the x^2 term was wrong, but in the vast majority of cases, both marks were readily scored.

(b) This caused very few problems, though a few of the students factorised out $16^{3/4}$ incorrectly or did not replace x by $\frac{x}{4}$ in their binomial expansion.

(c) Although not as well answered as parts (a) and (b), there were still a lot of correct solutions here, with many realising they simply had to multiply together their two series. Equally pleasing was that students did not waste time by finding terms that were not needed. The commonest errors involved adding together the two series or trying to divide one series by the other by dividing the coefficients of equivalent terms.

Question 5

(a) Although many students appeared to be familiar with deriving the identity for $\sin 3\theta$ using the suggested approach, there were also those for whom this appeared to be new territory. The most common error was to expand $\sin (2\theta + \theta)$ wrongly as simply $\sin 2\theta + \sin \theta$. This usually resulted in fruitless attempts at squaring their answer in the hope of achieving the printed answer.

(b) The majority of students appreciated the need to rearrange the identity found in part (a) in order to replace the $2\sin^3\theta$ before integrating, and there were a lot of completely correct solutions. There were also many who used this approach but failed to score full marks. Reasons for this included not being able to integrate the sin functions correctly; integrating the constant 3 to $3x$, rather than 3θ, or losing the term completely; or, more surprisingly, thinking that the given value for $\cos\frac{\pi}{6}$ of $\frac{\sqrt{3}}{2}$ meant that $\cos\frac{3\pi}{6}$ was $\frac{3\sqrt{3}}{2}$. The few that decided to ignore the structure of the question and use an alternative approach, usually integration by substitution, were usually far less successful and penalised accordingly.

Question 6

The topic of vectors is one that can cause problems especially amongst the weaker students.

(a) Most students knew to use either the x or y coordinate of point A in order to find the value of the parameter λ before showing that $p = 4$. Only very few failed to score in this part.

(b) This part was answered almost as well as part (a), with knowledge that the scalar product had to be zero very common. Some students used the scalar product definition to show that the angle between the lines l_1 and l_2 was 90° and, although this is obviously acceptable, it was not a necessary approach.

(c) Most students knew that they had to try to solve the three equations simultaneously and there were many fully correct solutions. There were, however, many cases of poor algebraic techniques when solving two of the three equations, with signs lost, or incorrectly subtracting when addition was needed, being quite common. Equally surprisingly, there were many cases of a correct form such as $7\mu = 2$ wrongly leading to $\mu = \frac{7}{2}$. As the last two marks depended upon accurate values, such mistakes proved costly. There were also a number of cases when the student tried to use the value of $\lambda = -1$ obtained in part (a).

(d) As in previous years, the final part of the vectors question caused problems. Use of the equal lengths of AC and BC was by far the most successful approach, though errors often occurred in forming vector $\overrightarrow{BC}$. A number of students who carried out a correct analysis failed to differentiate between the required coordinates of point B and those of known point A, which also of course arise from this approach. Those who wrongly used equal vectors $\overrightarrow{AC}$ and $\overrightarrow{BC}$ rather than lengths did not seem to be phased when point A was obtained. A few students were successful in using an approach based upon the midpoint of AB. Unfortunately there were also many fruitless approaches that obviously wasted a lot of the students' time.

Question 7

(a) Practically all students were well prepared in the process of implicit differentiation and there were many completely correct solutions. Although some errors did occur in differentiating individual terms, the often correct use of the product rule to deal with the $3e^{-2x}y$ term was generally pleasing to see. There were, however, a number of correct solutions that were spoiled when the student omitted the y from the $6e^{-2x}y$ term when rearranging their differentiated terms. This of course had a considerable effect on the rest of the question.

(b)(i) Those that successfully completed part (a) usually picked up both marks here. Although not penalised, answers such as $y = \frac{4}{6}xe^{2x}$ were equally as common as $y = \frac{2}{3}xe^{2x}$. Some students who omitted the y from their solution to part (a) did not appear to check their solution to part (a) despite it now being impossible to use the given information to find y as a function of x.

(b)(ii) This proved to be the most difficult part on the paper. Students needed to substitute the condition from (b)(i) into the equation of the curve and show that the resulting equation in x had a solution in the required range. The logical point of this, which students were not required to explain, was that it effectively verified that there was a suitable point satisfying (b)(i) that also satisfied the equation of the curve. While the nuances of this may have troubled a select few, a bigger issue for the majority may have been the need to use the change-of-sign technique drawn from their knowledge of an earlier unit. Most students simply tried to substitute the given values of x in their expression for $\frac{dy}{dx}$ and very few realised the need to also use the equation of the curve. The few who did appreciate this often completed the solution though a handful did wrongly use degree mode in their calculations.

Question 8

(a) This was intended mainly as a help in part (b), but was not as well done as might have been expected. There were some correct solutions but most students struggled with the somewhat unusual given form for the answer.

(b) The relevance of part (a) was not appreciated by most students, and there were many poor attempts at separating the variables into forms that could be integrated. Obviously with one eye on the printed answer, there were many solutions involving logarithmic functions but these were often completely wrong. There were few fully correct solutions to this part.

(c)(i) Most students, despite earlier problems, knew to substitute $x = 600$ into the printed answer and found the correct value of t. However there were many of these who were unable to translate this into the correct time of 2.20 pm.

(c)(ii) Most students were unable to correctly make x the subject of the printed answer to part (b). A handful were able to replace t by 4 and then make x the subject and, although this approach did not answer the first part of the question, it could be used, if correct, to earn the final mark. A frustrating few who did find the correct final value then spoiled their work by adding their answer to the initial 300 students.

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on how students have performed for each question.

Mark Ranges and Award of Grades

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

Converting Marks into UMS marks

Convert raw marks into Uniform Mark Scale (UMS) marks by using the link below.
UMS conversion calculator