A-LEVEL
MATHEMATICS

MPC4 Pure Core 4
Report on the Examination

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General

In general, the paper presented students with the opportunity to demonstrate their mathematical knowledge, though the later questions were invariably answered less successfully than the earlier ones.

There were only a handful of poor scripts with most students scoring well and quite a number demonstrating considerable knowledge of the specification. Presentation was generally good, though the more demanding later questions often required a number of restarts. Somewhat unnecessarily, a number of students used additional sheets when there was still room in the assigned answer booklet space.

Question 1

This proved to be a good first question with the majority of students scoring well.

(a) This was often answered correctly, with most students choosing to substitute appropriate values of x rather than setting up simultaneous equations. Only a handful of students set up the initial equations wrongly.

(b) Another part that was generally well answered, particularly when the students used the partial fractions to combine the series, though some struggled to introduce their values of A and B correctly. A minority of students reduced the expression $(4-3x)^{-1}$ incorrectly by taking out a factor of 3 rather than $\frac{1}{3}$ whilst those who chose not to use the partial fractions and multiply the three brackets together usually failed to obtain the final correct answer.

(c) This was the least well answered part of the question. Some students wrote down two correct inequalities but failed to make it clear which values of x satisfied both expansions and a considerable proportion failed to appreciate the required condition for convergence.

Question 2

This question was usually a good source of marks. Students constructed the required quadratic using the double angle formula and then factorized or used the quadratic formula accurately. Despite a correct factorisation or solution from the formula, a few students found the acute angle of $80.4°$ without finding the solutions in the relevant quadrants. Several included $0°$ and $360°$ with their solutions, ignoring the strict inequality for values of θ. Although this was not penalised, those who incorrectly included other angles, often $90°$ and $270°$, did lose the final mark. There was no issue with the accuracy requested in the question with practically all of the successful students giving their answers to the required one decimal place. Only a few students either misread the question or thought that $\cos 2\theta$ was the same expression as $\cos^2 \theta$.

Question 3

(a) Although many students used an identity approach to find the values of A, B, and C, a form of long division was by far the most popular approach. Both methods proved relatively successful although long division sometimes highlighted a weakness in relating the values obtained to those for B and C in the given structure. Invariably most found the $-3x$ term correctly. Only a few students were unable to obtain any values at all.

(b) This was another well answered part of the paper with nearly all students using their answer from part (a) to progress their integration. There were some careless arithmetic errors at the end when simplifying to the required form of the answer but, in general, this part also offered a reasonable return of marks for those who had wrong values of A, B, and C.

Question 4

(a)(i) This was answered well by a large proportion of the students, though a handful calculated k to more than 6 decimal places and then failed to write down the correct printed answer. Although only very few failed to appreciate how to find k, some failed to appreciate that the step from $k^8 = 0.5$ to the required answer did not necessitate the use of logarithms.

(ii) Again, many students scored full marks. Only occasionally was the number of days not given correct to the nearest day or rounded up rather than being given to the nearest day.

(b) Most students could interpret the information in the question and, as a result, achieved full marks. However some did not appreciate that Vanadium was a different element to Iodine and wrongly used the value of k obtained earlier rather than first finding the new value. Most used logarithms correctly, though taking logs in the less usual bases was very common. Again, occasionally, the number of days was not given correct to the nearest day.

Question 5

(a)(i) Most students could show the exact value printed by using the appropriate identity or a right-angled triangle approach. The very few who chose to use a calculator method to first find an angle such as $26.56°$ etc. or used $\cos\left(\sin^{-1}\frac{1}{\sqrt{5}}\right)$ were, of course, not rewarded here.

(ii) This was another high scoring part with many gaining full marks by clearly writing the appropriate identity, substituting correctly and showing the printed answer. It was evident that a number of centres used the double angle identity as a special case of $\sin(A+B)$ rather than an identity in itself.

(b)(i) Most students started well and gained full marks and it was evident that the students were very familiar with the appropriate trigonometrical identities. Of those that failed to gain full marks, many did not show any justification for the final printed answer or could not cope with the rationalisation of their initial answer. Only a very few could not proceed since they failed to obtain the necessary value of $\cos A$. However, in 'show that' questions, it should be stressed that working must be shown to justify a printed answer.

(ii) There were many fully correct solutions with the major shortcoming again being the inability to rationalise their initial answer into the required form.

Question 6

Most students made good attempts at the standard procedures tested in parts (a) and (b) but there were far fewer successful attempts with the more demanding aspect of part (c).

(a) Most students knew the formula $\mathbf{a.b} = ab\cos\theta$ and were generally successful in applying it to the correct vectors. There were, however, several cases of miscopying signs. In particular, after having obtained the vector $\begin{bmatrix} 4 \\ -12 \\ -20 \end{bmatrix}$ correctly, the incorrect miscopying to the vector $\begin{bmatrix} 4 \\ -12 \\ 20 \end{bmatrix}$ was far too frequent. Pleasingly few students used the wrong vectors to find the required angle.

(b) Again, most managed to form the three necessary simultaneous equations and were often able to solve them correctly. Verifying the consistency of their solutions in the third equation was less successful and usually without any explanation of what they were doing. Those who made any arithmetic error and came up with obscure values for λ and/or μ did not appear to think to check for any error.

(c) Although there were numerous ways of tackling this part, most seemed content to write down any knowledge of vectors that they had without regard to its relevance. Of those that had some success, the majority used the magnitude of the vectors, but as this involved squaring and equating there were often errors made, even when they were working with the correct vector. This usually resulted in no end result as the quadratic obtained became unmanageable. Again, some explanation of what they are doing or trying to do would help in the more demanding questions.

Question 7

(a) Most students were able to use parametric differentiation correctly, although the majority did not pick up full marks as the functions involved proved demanding to manipulate. An expression for $\frac{dx}{dt}$ was usually found correctly although sign errors were common and some students unnecessarily needed to use the quotient rule. Students were less successful in finding $\frac{dy}{dt}$ although the vast majority knew to use either the quotient or product rule since, although almost all could differentiate e^{3t} correctly, a common error was the $\frac{1}{3t}$ term wrongly becoming $3t^{-1}$ when used in the product rule. The vast majority substituted correctly and attempted to obtain an exact simplified answer; most found an expression for $\frac{dy}{dx}$ and then substituted numerical values rather than substituting first and this often led to further errors. Pleasingly, very few decimal answers were seen.

(b) There were some reasonably good attempts at this part, though a significant minority made slips when rearranging and clearly, and often wrongly, used the printed answer too readily. Students who took natural logarithms as their first step tended to be less successful.

(c) Many students failed to make any useful progress in this part even though the question was intentionally structured to help them. Those who did make a reasonable attempt were often thwarted by the demands associated with a given printed answer.

Question 8

Very few students made significant progress with this question.

(a) Some students managed to differentiate the expression using implicit differentiation but made little progress beyond that. There were a few instances where students wrote incorrect expressions such as $\frac{\mathrm{d}\theta}{\mathrm{d}x} = \sec^2\theta \frac{\mathrm{d}\theta}{\mathrm{d}x}$, or changed the variable using $\sec^2\theta \frac{\mathrm{d}y}{\mathrm{d}x}$. Many attempts to use the correct identity were unsuccessful because of algebraic weaknesses and a wrong value for k was common. A significant number of students did not read the question properly and did not use implicit differentiation as instructed, but instead used the formula given in the formulae booklet.

(b) Many students made little significant progress with this part of the paper. Several were able to separate the variables correctly, though some still lost the mark due to a missing part of the full expression. Unfortunately a lot of students made little meaningful progress beyond this point. A number recognised the need for, and attempted the use of, integration by parts on the $y\sin 3y$ term. Of those who used this method many could deal with the trigonometric function but there were sign errors or the angle $3y$ wrongly being written as y . Integrating the $\frac{1}{4+9x^2}$ term caused even more problems with very few seeing any link with the answer obtained in part (a). There were even many instances where $\frac{1}{4+9x^2}$ was integrated to give a logarithmic function or even split into $\frac{1}{4}+\frac{1}{9x^2}$ before integrating algebraically. Relatively few students reached a position to earn the last two marks because of the incorrect forms of their integrated functions.

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