AS
MATHEMATICS

MPC2 – Pure Core 2
Report on the Examination

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General

Students appeared to have the opportunity to score marks on topics throughout the whole paper, with the final part of many questions being the most demanding. It was pleasing to see that students were able to apply alternative methods for a variety of questions, such as finding the translation of the normal in 3(d) and the summation of the terms of the series in 4(b)(ii). The vast majority of students seem to have had the time to tackle all that they could answer. Presentation of work was generally good although, for a minority of students, there was a lack of brackets in some of their expressions, notably in the trapezium rule.

Teachers may wish to emphasise the following points to their students in preparation for future examinations in this unit:

- When asked to show a printed result it is important to show sufficient details in the solution to justify stating the result. So, for example, in 6(a) students were expected to show more than three significant figures for the angle in radians before writing down the printed value 0.586
- Students are required to use the correct terminology and notation for transformations. For example, in 5(b)(i), in addition to the word 'translation', students were expected to also state the vector $\begin{bmatrix} 0 \\ 5 \end{bmatrix}$. When asked to describe a single transformation that maps one graph onto another, it is important to relate the equation of the transformed graph directly to the equation of the original graph. So, for example, in 5(b)(ii), $3\sqrt{x^2+1}$ should be written as $\sqrt{(3x)^2+9}$ before comparing with $\sqrt{x^2+9}$.

Question 1

(a) This was generally answered correctly by those students who initially expressed $\frac{36}{x^2}$ in the form $36x^{-2}$. The most common errors were to differentiate the integrand or to integrate $\frac{36}{x^2}$ as $\frac{36}{\frac{1}{3}x^3}$.

A minority of students could not integrate ax correctly.

(b) Most students scored the method mark for attempting to evaluate $\mathrm{F}(3) - \mathrm{F}(1)$, but a large minority did not find the correct value of the constant a. The most common error was an incorrect sign in the expansion of the second bracket.

Question 2

(a) The majority of students failed to score full marks. Although most students correctly identified the y-intercept as 1 and sketched an exponential graph, many incorrectly sketched an increasing exponential function.

(b) This part was almost always answered correctly, either by taking logarithms to the same base of both sides of the equation, or by using $x = \log_{0.2} 4$. A small number of students failed to give the final answer to a sufficient degree of accuracy, despite three significant figures being specified in the question and an even smaller number failed to score any marks because they did not explicitly show that logarithms had been used.

(c) A large majority of students failed to score this mark. The most common wrong answer was a stretch of scale factor 25, parallel to the y-axis.

Question 3

(a) The overwhelming majority of students were able to write down $\frac{dy}{dx}$ with the correct index for x and retain the '-1' term from differentiating the linear part.

(b) A significant minority thought that either the second derivative and/or inequalities were needed, for which there was no credit. The overwhelming majority, however, correctly equated their expression for $\frac{dy}{dx}$ to zero. A minority then lost their way trying to make x the subject, but most squared correctly to find $x = 9$. Having done so, they had little trouble in substituting into the original expression to find y correctly.

(c) The vast majority of students evaluated $\frac{dy}{dx}$ correctly at $x = 4$ but some did not change the sign, as well as inverting to find the gradient of the normal. Students with the correct gradient nearly always presented a correct equation for the normal. The final part provided a more discriminating challenge, particularly as there were a number of possible approaches that the student could choose. Those who simply added (or subtracted) k to their normal equation (essentially translating in the y direction) received no credit. The simplest algebraic approach required x to be replaced by $x - k$ and then fitting the coordinates of M to find k. Graphical approaches were also evident. The most common was to find x when $y = 6$ on the original normal equation (giving $x = 3.5$) and then finding the k needed to translate horizontally to the x-coordinate at M. The most common error in any of these and other approaches was to have the wrong sign for k.

Question 4

(a) The vast majority of students used the relevant arithmetic series formula to convincingly obtain the printed equation and so scored full marks.

(b)(i) A significant minority of students could not translate the given information ‘the sum of the second term and the third term is 50’ into a correct equation. The successful students generally started with $(a+d)+(a+2d)=50$, but other valid approaches, for example, $S_3 - a = 50$, were also seen. Those students who set up a correct equation generally solved the simultaneous equations correctly to find the values for a and d and subsequently found the correct value for u_{12}

(ii) The usual error was seen, namely, students working with $S_{21} - S_4$, which only achieved one mark, instead of using $S_{21} - S_3$. A minority of students tackled this final part by considering the required series to be one which started with u_4 but many of these approaches failed due to the number of terms in the series being taken as 17 instead of 18.

Question 5

(a) Most students applied the trapezium rule correctly and only a very small number of students failed to give their final answer to the required degree of accuracy. In addition to arithmetical errors, the two most common method errors were omission of the outer brackets in the trapezium rule resulting in an incorrect calculation and the use of values of x, normally starting at 0, which were outside of the interval $[2,11]$.

(b)(i) A large majority of students gave the correct answer with the word ‘translation’ being used together with the vector $\begin{bmatrix} 0 \\ 5 \end{bmatrix}$. Some students used incorrect terminology with words such as ‘shift’ and some did not show the correct vector form, for example, ‘translation 5 in the y direction’.

(ii) Only a small minority of students gave a correct answer to this challenging part. A ‘stretch in the y direction scale factor 3’ and a ‘stretch in the x direction with incorrect scale factor’ were commonly seen. Successful students were generally those who took the factor of 3 inside the square root in order to compare it with the given equation in the stem of the question.

Question 6

This question was a good source of marks for many of the students.

(a) The vast majority of students scored the two method marks for applying the cosine rule and reaching a correct numerical form for $\cos\theta$. A significant minority of those students who scored the method marks failed to score the final mark because they just stated the printed answer, 0.586, without giving the value of θ to a greater degree of accuracy to justify that $\theta = 0.586$ correct to three significant figures. Although rare, it was disappointing to see some students just substituting all the values, including 0.586, into the cosine rule and claiming that $\theta = 0.586$ because the right-hand side was approximately 25.

(b) A high proportion of students scored both marks for finding the correct area of the triangle. A common wrong value after seeing the correct $\frac{1}{2}\times 9\times 8\sin\theta$ included 21, likely calculated from $\frac{1}{2}\times 9\times 8\theta$.

(c) Many students quickly realised that the area of the sector was half of that found in part (b) and managed to find the radius. Although a slight majority of those who found the correct radius subsequently went on to find the required perimeter successfully, a significant proportion either made arithmetic slips or, more seriously, took the perimeter to be one consisting of two radii and an arc length or treated it as perimeter of triangle minus perimeter of sector.

Question 7

(a) This part was generally very well answered with most students applying the binomial expansion to obtain the correct three values. The most common error was to lose the negative sign.

(b) many students attempted the whole series rather than picking out the terms required. Although this was not penalised, time could have been saved by just looking for the correct three combinations. A large proportion of students scored the marks for the series but then a significant minority of these picked out the wrong terms to group, with x^2 times x^5 being a common wrong method to find the coefficient of x^{10}.

Question 8

(a)(i) A significant majority of students found the correct value for $\tan x$. Those students who scored the method mark but not the accuracy mark frequently had an incorrect sign in their rearrangement of the given equation. Students who just changed the equation into an expression failed to score.

(a)(ii) The most successful students started with $1 - \tan x = 0$, $4\sin x + 5\cos x = 0$ and then solved $\tan x = 1$ and $\tan x = -1.25$ to obtain all four solutions. Many students seemed unaware that the product of two expressions equals zero implies either expression being zero. It was quite common to see $\tan x = -1$ stated.

(b) This part proved to be too demanding for many students, although a majority of students did gain the method mark for replacing $\sin^2\theta$ by $1-\cos^2\theta$ in the given expression. The expression $\dfrac{25-9\cos^2\theta}{5-3\cos\theta}$ was subsequently often cancelled down using incorrect mathematics. The majority of students had either $5-3\cos\theta$ or $5+3\cos\theta$ as their expression, but relatively few students scored the final mark. Most students equated their answer to 0 and stopped, or attempted solutions for $\cos\theta = \pm\dfrac{5}{3}$. Some students stated that the minimum value of $\cos\theta$ was -1 but then attempted to solve $5+3\cos\theta = -1$. A small number of students were unfortunate in that they either stated the least value 2 or stated $\theta = \pi$ but not both.

Question 9

(a) The majority of students correctly changed $\log_3 c = m$ to $c = 3^m$ and $\log_{27} d = n$ to $d = 27^n$. Changing d^2 correctly to a power of 3 proved to be challenging for the majority of students with $d^2 = 729^{2n} = 3^{12n}$ being a common error. Students were generally more successful in writing $\sqrt{c} = 3^{0.5m}$. Those students who changed $\sqrt{c}$ and d^2 to the correct powers of 3 usually went on to correctly express $\dfrac{\sqrt{c}}{d^2}$ in the form $3^{\frac{m}{2}-6n}$.

(b) Those students who made a realistic attempt at answering this part generally scored the method mark for correctly writing the left-hand side of the given equation as a single logarithm. There was less success in eliminating all logarithms to obtain a correct quadratic equation. For the final mark, students were expected to do more than just state the value of x. The most common approach by the successful students was to consider the discriminant and to show that $b^2 - 4ac = 0$ for the correct quadratic equation.

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