GCE

MATHEMATICS

MPC3 Pure Core 3
Report on the Examination

6360
June 2013

Version: 1.1

Further copies of this Report are available from aqa.org.uk

General

The students coped well with the length of the paper and most of them attempted all ten questions with confidence. However, many students appeared not to have a good understanding of the graph of the inverse cosine function. The sketching of the modulus graphs was also often poorly attempted. In the sketches, correct curvature and marking of the values of the intercepts with the co-ordinate axes were expected from the students. Students need to be aware that brackets are often a crucial part of algebraic expressions and that they risk losing marks if they do not use them properly. Some marks were lost due to giving decimal values to insufficient degree of accuracy or not rounding results as requested. Some students seemed to be unaware that indefinite integrals gave rise to a constant of integration but that differentiation gives a single answer. As stated in the rubric of the paper, students should be aware that working should be shown and those who fail to do so may be penalised.

Question 1

(a) The students who understood the concept gained three marks easily, either by using two equations or by squaring both sides. A few solved all four relevant equations obtaining repeated values of x. However, it was disappointing to see many wrong approaches, particularly those which gave intercepts with the axes or answers such as $|x| = |3|$. The sketch was there to help; so values such as -3 should have been spotted as being clearly incorrect.

(b) Many students spoiled their answers by giving combined inequalities such as $1 {}^3 x {}^3 3$. Other incorrect responses included the interval $1 \le x \le 3$ or the use of "$x \le 1$ and $x \ge 3$". Again, the sketch was there to assist, and it was good to see some students marking the diagram to help them chose the correct part.

Question 2

This question was well answered by the great majority of the students.

(a) Any errors that occurred were usually associated with the second term where $\tan 2x$ was differentiated to $\sec^2 2x$ or $2\sec^2 x$ instead of $2\sec^2 2x$. Attempts at using the quotient rule on $y = \dfrac{x^4 \sin 2x}{\cos 2x}$ was often prone to errors.

(b) Most students used the quotient rule correctly, although some had the two terms in the numerator reversed. Those who chose to use the product rule were mostly correct, with a few making a sign error. A small number of students failed to go on substituting $x = 3$ into their derived equation. A common incorrect answer was $\dfrac{3}{2}$; arising from students expanding the denominator incorrectly to $x^2 - 2x - 1$.

Question 3

The great majority of students gained full marks for this question.

(a) The evaluations of the function for $x=3$ and $x=4$ were correct in almost all scripts. But some students failed to make a full statement that mentioned both the change in sign of the function as well as the presence of a root between $x=3$ and $x=4$.

(b) Almost all students gained full marks. A few students confused "three decimal places" with "three significant" figures or gave 3.88 instead of 3.880 for x_2.

(c) Almost all students gained both marks except for very few cases where x_2 and x_3 were not marked on the x-axis.

Question 4

This was a very well answered question with a high proportion of students gaining full marks. A small number of students failed to round results to three significant figures or gave their answers in degrees. Some lost marks through sign errors when collecting the terms of the quadratic together prior to factorisation. The most fundamental error seen was where students tried to write everything in terms of $\tan x$ and occasionally the equation $8(1+\tan x)-2(1+\tan^2 x)=\tan^2 x-2$ was seen. Those who changed to sine and cosine at the start had to convert to an equation all in cosine to earn marks and some did not go far enough.

Question 5

(a) Although there were many fully correct solutions, some students lost marks by failing to show that they were working to the required accuracy. It was necessary to use values of y to at least four significant figures as the answer was required to three significant figures. Students should be encouraged to show their answer to greater degree of accuracy than required and then proceed to give the rounded answer. A few students used only four strips instead of five and this gained no credit.

(b) It was evident that many students did not understand the concept of the mid-ordinate rule even though they were able to apply the formula to answer part (a). Even though the question stated "With the aid of a diagram" only a verbal response was often given. Many diagrams that were drawn illustrated the trapezium rule.

Question 6

Many students appeared to have covered this part of the specification very superficially. Many students earned no marks for this question because they did not appreciate that the functions were only valid over a restricted domain. Students should be aware that when co-ordinates are requested these should be stated separately as an ordered pair; in this instance credit was given for correct values marked on the axes, but this was a generous concession.

(a) Some students lost the sketch mark because their gradients were wrong or their curves did not reach the x-axis. A small number of students had the y values as $\frac{\pi}{2}$ or 2π. Some students drew the cosine graph or the graph of $\frac{1}{\cos x}$ while a significant proportion did not attempt this part of the question.

(b) All the above issues surfaced again in this part. Some of the students who earned the marks for part (a) carried out wrong transformations.

Question 7

The responses to this question suggested that transformations and curve sketching need more attention.

(a) A common incorrect response was to reflect the curve in the y-axis. Where students correctly reflected in the x-axis, errors occurred in indicating the intersection with the x-axis where answers of 6 and 18 were common. On the y-axis, $-\frac{4}{3}$ and -12 were often seen.

(b) The most common sketch seen was a copy of the original curve with the part of the curve for $x < 0$ reflected back into the first quadrant. Of those who attempted to reflect in the y-axis, some failed to give a recognisable cusp at $(0, 4)$ and many reflected the 'ends' beyond ± 6 in the x-axis.

(c) This part was better answered than the two previous parts. The main errors here were giving a stretch factor of -2 or $\frac{1}{2}$, or giving reflection in the x-axis or in the line $y = x$ instead of the y-axis. Students should note that "a horizontal stretch" is not sufficient and the answer should be given as "stretch parallel to the x-axis".

Question 8

This question was tackled well with many students gaining 11 marks. It was good to see a better understanding of the connection between the exponential and logarithmic functions than in previous series.

(a)(i) This part was well answered with many fully correct responses. The great majority of the students gained the mark for swapping *x* and *y*; most students did so at the start. Marks were lost by a small number of students because they could not change logarithm to exponential form.

8(a)(ii) To earn the mark it was essential to give $\mathrm{f}^{-1}(x) > \frac{3}{2}$, but many used x or y or f^{-1} or range or $\geq$ and these were not acceptable.

(iii) The correct graph was usually seen and many students gained full marks. However, some students allowed the gradient in the second quadrant to become negative, some had the wrong intercept and some had the graph in completely the wrong place, failing to recognise they needed to reflect in the line $y = x$.

(b)(i) The correct composition was usually applied and many students went straight to the answer. There were some students who had difficulty with manipulating $\mathrm{e}^{2\ln(2x-3)}$ to $\mathrm{e}^{\ln(2x-3)^2}$.

(ii) Most students chose the correct composition and gained the method mark. Although many students went on to complete the question correctly, handling of the logarithms proved beyond many and $\ln(2\mathrm{e}^{2x} - 11)$ was often changed into $4x - 11$. Necessary brackets were often omitted.

Question 9

Many students scored full marks here. Those who did not gain all the marks generally lost them at the start when they made sign errors in isolating x^2. Other errors mainly involved the handling of the 16. An error that frequently occurred on integration was that the constant often became a multiple of x, e.g. $\frac{\pi}{16}\left(\frac{y^3}{3} - 8y^2 + 96x\right)$; although most recovered on the next line by using the correct limits.

Question 10

(a)(i) The great majority of the students made progress here, most integrating correctly but some losing the final accuracy mark because of the omission of the constant of integration which was needed for the indefinite integral.

(ii) There were three main approaches here and the most popular was to use $u = \ln x$, $\frac{dv}{dx} = \ln x$. If the answer to part (i) was correct often all the marks were scored but sometimes there was a sign error in the final line. Using $u = (\ln x)^2$, $\frac{dv}{dx} = 1$ was also successful for many students, although the omission of brackets on the first term lost the accuracy mark. Some students were not able to differentiate $(\ln x)^2$ correctly. The third approach was using substitution for $\ln x$, but not many were able to follow that through and revert to a function of x. There were some poor attempts such as $u = (\ln x)^2$, $\frac{du}{dx} = \frac{1}{x^2}$ and $\int (\ln x)^2 \, dx = \frac{(\ln x)^3}{3}$.

10(b) Most students correctly made the initial step of finding $\frac{du}{dx}$ correctly. A small number of students wisely set $x = u^2$ and found $\frac{du}{dx}$. Writing the integrand in terms of u was found to be very challenging by many students and numerous attempts at falsely cancelling $x^{-\frac{1}{2}}$ prior to substitution often resulted in expressions that gained no further credit. Many who did get to the required expression failed to move on as they did not cancel by u and thought they could integrate to $\ln(u^2 + u)$. The more fundamental errors were $\frac{u}{u^2 + u}$ becoming $\frac{1}{u^2 + 1}$ or $\frac{1}{u^2} + 1$. Students should be made aware that the whole expression needs to stay within the integral; some had $2u$ or the equivalent outside the integral. Some students who got to the last line used the x limits in the u expression.

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 www.aqa.org.uk/umsconversion