AQA

AS

MATHEMATICS

MPC1 Pure Core 1
Report on the Examination

6360
June 2016

Version: 1.0

General

It was again encouraging to see that the question paper provided a suitable challenge for more able students, whilst at the same time allowing weaker students to demonstrate their understanding of coordinate geometry, differentiation, integration, factorising polynomials and rationalising the denominator of surds. There seemed to be plenty of time for students to complete the paper, with very few showing any signs of rushing towards the end.

Although the majority of students presented their work well, some did themselves a disservice in this respect. Overwriting of figures and signs were often unclear; expressions should always be written out again so that there is no confusion for the examiner.

When an answer is requested in a particular form, such as the equation of a straight line, students will not score full marks if their final answer is not in that specific form. Careful attention needs to be given to proofs when a printed answer is given, where once again the final line of a student's working should exactly match the printed answer.

Algebraic manipulation continues to be a weakness; this was very evident when solving simultaneous equations, multiplying out brackets and factorising quadratic expressions. The correct use of brackets is often necessary to gain full marks in a question.

The standard of arithmetic was unfortunately poor, particularly in the handling of negative numbers or fractions. The number of arithmetic errors suggested that some students have become over-dependent on a calculator for simple arithmetic. Fractions occurred in a number of questions, and often caused problems.

Weaker students might benefit from learning accurately a few basic formulae, such as the general equation of a circle and the quadratic equation formula so as to avoid losing precious marks.

Future students might appreciate the following advice:

- The straight line equation $y - y_1 = m(x - x_1)$ could sometimes be used with greater success than always trying to use $y = mx + c$
- The only transformation occurring in this unit is 'translation' and column vectors should be used to describe a translation
- The quadratic equation formula needs to be learnt accurately and values substituted correctly or no marks will be earned
- The minimum value of $(x+p)^2+q$ is q
- A concluding statement is expected whenever a question asks for a particular result to be proved or verified
- When asked to use the Factor Theorem, students are expected to make a statement such as 'therefore $(x+3)$ is a factor of $\mathrm{p}(x)$' after showing that $\mathrm{p}(-3) = 0$
- The circle with equation $(x-a)^2+(y-b)^2=k$ has centre (a, b) and radius $\sqrt{k}$
- Where a printed answer appears in a question, students must reproduce this exactly with terms in the correct order on their final line
- When solving a quadratic inequality, a sketch or a sign diagram showing when the quadratic function is positive or negative could be of great benefit.

Question 1

(a) Most students rearranged the equation of the line AB to make y the subject and hence found the correct gradient of AB. Some students then simply wrote "gradient $= -\frac{5}{3}$" instead of explicitly writing $m = -\frac{5}{3}$, leaving examiners in doubt as to whether they had actually found the gradient of the parallel line. Others insisted on writing $y = -\frac{5}{3}x + 7$ instead of clearly stating the value of m. Some students wrote $m = \frac{3}{5}$; confusing the terms parallel and perpendicular.

(b) The majority of students made an attempt at solving the simultaneous equations and usually obtained the correct solution. However, poor arithmetic sometimes led to errors in the elimination of x or y and hence the loss of marks. Students who solved the equations by elimination rather than substitution were usually more successful.

(c) Most students scored well by directly substituting the coordinates of the point into the given equation of the line AB, provided they used brackets correctly. Those students who attempted to substitute the coordinates into a rearranged form of the equation of the line AB, or who attempted to link the coordinates of the point with another point on the line and the gradient were often unsuccessful, as they were unable to cope with the resulting algebra.

Question 2

This was a high scoring question with many students scoring full marks. Rationalising the denominator continues to be a skill that is well practised. Most of the wrong answers came from carelessness with signs or arithmetic. The most common arithmetic error arose from simplifying the numerator, usually when combining the four terms or when multiplying 45 by 7. Some students made errors in evaluating the middle terms of the denominator, writing things like $-7\sqrt{5} + 7\sqrt{5}$ and were penalised; others found difficulty simplifying $49 - 45$. There were also a few errors seen when going from the penultimate line with the correct numerator and denominator to the final line due to incorrect division by 4.

Question 3

(a)(i) This part of the question was answered with mixed success. Many knew that completing the square was required, however not all of these students were able to do so successfully. Arithmetic errors in finding $-\frac{41}{4}$ were quite common, often due to problems squaring $-\frac{7}{2}$.

(ii) This part was answered less successfully, as many gave a pair of coordinates or sometimes a value of x instead of their value of q from part (a)(i).

(b) Although some thought that two transformations were involved, many recognised that just one was needed and that it was a translation. There were fewer students using incorrect terms such as 'slide' and 'move' rather than the word "translation" this year. Identification of the correct vector was not done so well, however. It was quite common to see sign errors in one component and sometimes both components of the vector.

Question 4

This was a high scoring question with many students achieving full marks.

(a) The vast majority of students realised the Factor Theorem required them to find the value of $\mathrm{p}(x)$ when $x=-3$ and most showed their evaluation of $\mathrm{p}(-3)=0$ correctly. Regrettably, a few students did not show that they had handled the powers of -3 correctly after the substitution and so could not earn the final accuracy mark. For the accuracy mark it was also necessary to write a concluding statement that $(x+3)$ is a factor of $\mathrm{p}(x)$. Most students realised this necessity and made an adequate statement either before or after correct working.

(b) Several methods were employed to find the quadratic factor. Students who used an inspection or grid method made fewer arithmetical errors than those who employed long division, synthetic division or the equating of coefficients. A few students sought further linear factors via the Factor Theorem. This was not very successful, due to both the repeated factor and the number of arithmetical errors made.

(c) Again, most students understood that the Remainder Theorem required them to evaluate $\mathrm{p}(2)$ and most did this successfully. A few students attempted to find the remainder using long division or evaluated $\mathrm{p}(-2)$ and therefore scored no marks.

(d) This was the least well attempted part of this question. Most students attempted long division or the equating of coefficients and some made small arithmetic errors that led to the wrong final answer. The connection between parts (c) and (d) of this question was not always made, with some students not recognising that the remainder of 20 from part (c) should also be the value of r in part (d). Thus, this fact was not used to check their answer. A few students answered the question effectively by dividing $\mathrm{p}(x)-20$ by $x-2$.

Question 5

(a) The vast majority of students were able to write the left hand side of the circle equation correctly. Sign errors were very uncommon this year as was using the point A instead of C. Most of the errors were in calculating the value of k. Most students used Pythagoras but then spoiled their answer by adding or subtracting other extra numbers, imagining that they had completed the square.

(b) Most students answered this question without the help of a diagram. A significant minority found the equation of the tangent or normal before eventually writing down the correct coordinates of the point B.

(c) A significant minority used the gradient of AC as the gradient of the tangent. Most students made a good attempt at this question but arithmetic slips seemed more common than sign errors when calculating the gradient. Some students thought that the gradient was the difference in x-coordinates divided by the difference in y-coordinates. Most students gave the equation of the line in the required form.

(d) Some credit was given for using the student's value of k. A diagram might have helped those students who used Pythagoras incorrectly. Students were penalised for using incorrect statements such as $4^2 + 65 = \sqrt{81} = 9$ when calculating the length of CT.

Question 6

This was the least well answered question and revealed just how dependent some students have become on using their calculators to solve quadratic equations and to sketch graphs.

(a)(i) The need to solve the equation $8 - 4x - 2x^2 = 0$ was generally well understood, although many students struggled with manipulating the minus signs. There were two main approaches to solving this equation although, in both approaches, many students struggled with the algebra involved. Of those who chose to use the quadratic formula, the main error came from the division of their irrational term by their denominator, if it was even considered at all. The use of the quadratic formula was poor; those who managed to obtain a correct form almost invariably simplified their surd expression wrongly. Students who chose to complete the square often struggled with the negative coefficient of the x^2 term. There were also a small number of students who did not give their final answer in the form required in the question and this was penalised.

(ii) Although the shape and intercept of the negative quadratic were well known, the majority of students failed to place the vertex correctly to the left of the y-axis.

(b)(i) This was answered better than similar proofs in previous years. However, students should be encouraged to write one line of working for each step. Those who take more than one step at a time are not only far more likely to make an error but also less likely to produce a convincing argument. Those who did lose the mark often did so because they failed to reproduce the printed answer exactly or included incorrect trailing equals signs in their working.

(ii) A significant number of students did not know how to approach this question. Of those who did, again, there were two main approaches. Those who chose to solve 'discriminant = 0' were usually successful. However, incorrectly identifying the coefficients of the quadratic, a lack of understanding of the need for the discriminant to be equal to zero, poor algebra skills or poor use of brackets were the barriers to full marks. A small number of students chose a differentiation approach, and while a number of very elegant solutions were seen, the vast majority using this method were unable to move beyond equating the two gradients, thus gaining no marks.

Question 7

(a)(i) Most differentiated correctly to obtain the gradient and it was gratifying to see that nearly everyone recognised that $\frac{\mathrm{d}y}{\mathrm{d}x}$ gave the gradient of the tangent with only a few finding the equation of the normal. Some arithmetic errors occurred when trying to produce an equation of the required form.

(ii) Those who had established a straight line equation generally scored the follow through mark here, although some students had a sign or other arithmetic error and others substituted $x = 0$ and found the value of y.

(b)(i) The integration was handled well, with the 4 term at the beginning causing most errors – it was sometimes omitted and sometimes left as 4. Most dealt well with the negative limit, with the minus sign and with removing the brackets. Many scored the first few marks but their work in combining fractions sometimes let them down. When tackling definite integrals students are encouraged to consider an expression of the form $\mathrm{F}(b) - \mathrm{F}(a)$ holistically rather than working with separate entities, as it is not always clear when they combine later that subtraction has taken place. Students are also advised to show the correct substitution of limits before attempting any simplification as a small arithmetic mistake could render their method incorrect.

(ii) There were many fully correct solutions here, and most students scored at least one mark for their method. However, considering that they were given the relevant diagram, it was disconcerting to see calculations of the area of a trapezium or parallelogram when it should have been evident that a triangle was needed. A few students tried to find the area of the region below the line using integration but very few of them were successful.

Question 8

(a)(i) The majority of students scored full marks here for differentiation.

(ii) Many students seemed reluctant to write $\frac{dy}{dx} = ...$ and $\frac{d^2y}{dx^2} = ...$ and presented examiners with a string of numerical calculations. Only occasionally was this part done well. Most students only considered $\frac{d^2y}{dx^2}$ not realising that both the first and second derivatives needed careful consideration.

(b)(i) In short proofs like this, students should be encouraged to rewrite a line of working rather than scribble over and alter their work, especially where signs such as $<$ and $>$ are involved. Students did not always take the necessary care to ensure that their final line of working matched the answer printed in the paper. The poor manipulation of inequalities often cost students the accuracy mark in this proof.

(ii) It was encouraging this year to see most students attempting to factorise the quadratic rather than using the formula. Those who used a sign diagram or a sketch graph usually were more successful when solving the inequality.

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