General Certificate of Education

Mathematics 6360

MPC1 Pure Core 1

Report on the Examination

2010 examination – June series

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General

The paper seemed to provide a challenge for the very able candidates whilst at the same time allowing weaker candidates to demonstrate basic skills such as differentiation, integration, rationalising the denominator of surds. Several examiners commented on the many arithmetic errors and the lack of basic numeracy skills in this examination when calculators cannot be used. In addition, poor algebraic manipulation remains a problem for many. Some candidates might benefit from 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 tangent to a curve at the point P has the same gradient as the curve at the point P
- The normal to a circle with centre C at the point P is the straight line which passes through C and P
- When asked to use the Factor Theorem or Remainder Theorem, no marks can be earned for using long division
- When using the factor theorem, it is not sufficient to show that $\mathrm{p}(-3) = 0$. A statement such as "therefore $x + 3$ is a factor" should appear
- A quadratic equation has real roots when the discriminant is greater than or equal to zero ($b^2 - 4ac \geqslant 0$)
- A sign diagram or a sketch graph showing the critical values might be helpful when solving a quadratic inequality.

Question 1

Part (a) Many candidates were unable to make y the subject of the equation $2x + 3y = 14$ and, as a result, many incorrect answers for the gradient were seen. Those who tried to use two points on the line to find the gradient were rarely successful.

Part (b)(i) Those candidates who obtained a value for the gradient in part (a) were usually aware that the line DC had the same gradient. Those using $y = mx + c$ often made errors when finding the value of c, whereas those writing down an equation of the form $y - y_1 = m(x - x_1)$ usually scored full marks.

Part (b)(ii) Most candidates realised that the product of the gradients of perpendicular lines should be -1 and credit was given for using this result together with their answer from part (a). Careless arithmetic prevented many from obtaining the final equation in the given form with integer coefficients.

Part (c) Although many correct answers for the coordinates of B were seen, the simultaneous equations defeated a large number of candidates. No credit was given for mistakenly using their equation from part (b)(i) or part (b)(ii) instead of the correct equation for AB, clearly printed below the diagram. Many did not recognize the need to use the equation of AB at all. It was common to see $x = 0$ or $y = 0$ substituted into the equation for BC and then solved to obtain the other coordinate.

Question 2

Part (a) Many candidates were successful with this part, although sign errors and arithmetic slips were common.

Part (b) Most candidates recognised the first crucial step of multiplying the numerator and denominator by $1-\sqrt{5}$ and many obtained $\frac{44-20\sqrt{5}}{-4}$, but then inaccurate evaluation of the numerator or poor cancellation led to many failing to obtain the correct final answer.

Question 3

Part (a)(i) Those who used long division instead of the Factor Theorem scored no marks. Most candidates realised the need to show that $\mathrm{p}(-3) = 0$. However quite a few omitted sufficient working such as $\mathrm{p}(-3) = -27 + 63 - 21 - 15 = 0$, together with a concluding statement about $x + 3$ being a factor, and therefore failed to score full marks.

Part (a)(ii) Many candidates have become quite skilled at writing down the correct product of a linear and quadratic factor and then writing $\mathrm{p}(x)$ as the product of three linear factors and these scored full marks. Others used long division or the Factor Theorem effectively but lost a mark for failing to write $\mathrm{p}(x)$ as a product of linear factors. Others tried methods involving comparing coefficients, but often after several lines of working were unable to find the correct values of the coefficients because of poor algebraic manipulation. Speculative attempts to write down $\mathrm{p}(x)$ immediately as the product of three factors were rarely successful.

Part (b) Those candidates who used the Remainder Theorem were usually able to find the correct remainder, though once again arithmetic errors abounded. Those who used long division, synthetic division or other algebraic methods again scored no marks since the question specifically asked candidates to use the Remainder Theorem.

Part (c)(i) This part of the question was intended to help candidates when sketching the curve. Those who found the correct values of $\mathrm{p}(-1)$ and $\mathrm{p}(0)$ usually scored the mark but in future a carefully written proof may be called for. Here again many arithmetic errors were seen.

Part (c)(ii) The sketch was intended to bring various parts of the question together but even very good candidates ignored the hint from part (c)(i) and showed a minimum point on the y-axis. A few lost the final mark when their curve stopped on the x-axis. Confusion between roots and factors spoiled many sketches and several showed the y-intercept of -15 on the positive y-axis. It was disappointing that many candidates did not recognize the shape of a cubic curve at all.

Question 4

Part (a)(i) Most candidates were able to integrate the expression with only the weakest candidates unable to do this basic integration. Poor notation was used with many including the integral sign after integrating. It would have been thought that this bad habit would have been corrected by the time of the examination. Many candidates did not find the actual value of the definite integral until part (a)(ii) and on this occasion full credit was given. It was alarming that many candidates who had correct fractions were unable to combine these to give a value of 8.4 or equivalent. Weaker candidates were seen substituting values into the expression for y or $\frac{\mathrm{d}y}{\mathrm{d}x}$, showing a complete lack of understanding.

Part (a)(ii) It was necessary to consider a rectangle of area 18 and then to subtract their answer from part (a)(i) in order to obtain the area of the shaded region. Many believed that the area of the rectangle was 9 and others failed to do this basic subtraction correctly, even when their answer to part (a)(i) was correct.

Part (b)(i) Many candidates did not realise the need to find $\frac{\mathrm{d}y}{\mathrm{d}x}$ before substituting the value $x = 1$ and thus failed to score some easy marks for finding the gradient of the curve. A substantial number of candidates tried to calculate the gradient of the straight line between two points on the curve and scored no marks for this.

Part (b)(ii) Unfortunately many candidates tried to find the equation of the normal instead of the tangent to the curve. Otherwise, since there was a generous follow through in this part of the question, most were able to score this final mark. The only exceptions were those who insisted on using $y = mx + c$ where poor arithmetic often prevented them from finding a value for c.

Question 5

Part (a) Most candidates obtained the correct left hand side of the circle equation but many failed to recognize that the radius was 5. Alarmingly many thought that r was equal to –5 or wrote down the right hand side of the equation as -5^2 , thus displaying a fundamental misunderstanding of the idea of radius as a length.

Part (b)(i) Most who had the correct circle equation were able to verify that the circle passed through the point P, although those who neglected to make a statement as a conclusion to their calculation failed to earn this mark.

Part (b)(ii) The negative signs caused problems for many when finding the gradient of PC and only the better candidates obtained the correct value. Many candidates then found the negative reciprocal of this fraction instead of using the gradient of PC to find the normal to the circle at the point P.

Part (b)(iii) There were basically two approaches to this question, although some candidates were merely guessing and no credit was given for a correct answer without supporting working.

The most common method involved distances or squares of distances; many made errors in finding the coordinates of M and then struggled with the fractions when squaring and adding to find the length of PM; whereas others noted that the length of PM was simply half the radius. A simple comparison with the length of PO led to the correct conclusion.

The second approach was essentially one using vectors or the differences of coordinates, but this method was not always explained correctly and left examiners in some doubt as to whether candidates really understood what they were doing. The best candidates wrote down the correct vectors $\overrightarrow{PM}$ and $\overrightarrow{OP}$ and reasoned that these vectors had the same y-component but different x-components and it was then easy to deduce that P was closer to the point M.

Question 6

Part (a)(i) Usually after a few abortive attempts many candidates realised that they had to add together the areas of the various faces. Once they had the correct expression for the total surface area most candidates were able to obtain the printed result. There was clearly some fudging on the part of weaker candidates and they could earn little more than a single method mark.

Part (a)(ii) This was surprisingly one of the biggest discriminators on the paper with only the best candidates being able to obtain the correct expression for V. Trying to make y the subject of the equation from part (a)(i) caused problems for many who took this approach; others substituted for xy in the formula $V = 6x(xy)$ and were often more successful. Once again it was quite common to see totally incorrect expressions being miraculously transformed into the printed answer.

Part (b)(i) Most candidates scored full marks for this basic differentiation although it was not always clearly identified as $\frac{dV}{dx}$ in their working.

Part (b)(ii) Most substituted $x = 2$ into their expression for $\frac{dV}{dx}$ and found the value to be zero. It was then necessary to make a statement about the implication of there being a stationary value in order to score full marks.

Part (c) Some made a sign error when finding the second derivative, but the majority of candidates scored full marks in this part. Credit was given if the correct conclusion was drawn from the sign of their second derivative, provided no further arithmetic errors occurred.

Question 7

Part (a)(i) Candidates did not seem well drilled in completing the square when the coefficient of x^2 is not equal to 1. It was very rare to see a correct answer here although a few did realise that $p = 5$. Clearly further practice is required at this type of question.

Part (a)(ii) Only the more able candidates were able to reason sufficiently well using the result from part (a)(i) as well as providing a concluding statement. No credit was given for using the discriminant to show that the equation had no real roots since the wording of the question excluded this approach.

Part (b)(i) This kind of question has been set several times before and the usual errors were seen. Candidates should state the condition for real roots ($b^2 - 4ac \geqslant 0$) and find an expression in terms of k for the discriminant using the correct inequality throughout. The inequality is then reversed when multiplying by a negative number. Again, many candidates would benefit from practising this technique, using brackets where appropriate to avoid algebraic errors.

Part (b)(ii) The factorisation of the quadratic was usually correct, but several candidates wrote down one of the critical values as $\frac{1}{7}$. Most found critical values and either stopped or immediately tried to write down a solution without any working. Candidates are strongly advised to use a sign diagram or a sketch graph showing their critical values when solving a quadratic inequality.

Mark Ranges and Award of Grades

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