GCE

MATHEMATICS

MPC1 Pure Core 1
Report on the Examination

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General

A number of examiners commented on problems with administration where the centre number or a candidate's entry number often had not been completed on the front of the booklet. Some additional sheets were not attached by treasury tags and were sometimes found inside the booklet of a different candidate. It would seem that some centres had simply handed every candidate an additional booklet for rough working. This practice is not to be encouraged and could result in a candidate's solution being marked down for submitting two separate solutions for the same question, neither of which has been crossed out.

Once again, the question paper seemed to provide a suitable challenge for able candidates whilst at the same time allowing weaker candidates to demonstrate their understanding of differentiation, integration, rationalising the denominator of surds and polynomials. Basic items, such as the general equation of a circle and the solution of quadratic equations by factorisation, need more attention by the weaker candidates. Algebraic manipulation continues to be a weakness, in particular, the use of brackets and dealing with negative signs. The number of arithmetic errors suggested that some candidates have become too dependent on a calculator for simple arithmetic, particularly when handling fractions. If a question asks for a particular result to be proved or verified then a concluding statement is expected.

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 quadratic equation formula needs to be learnt accurately and values need to be substituted correctly or no marks will be earned.
- 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.
- The only geometrical transformation tested on MPC1 is a **translation** and this particular word must be used rather than "trans" or "shift" etc.
- The minimum value of $2(x + p)^2 + q$ is q.
- When asked to use the Factor Theorem, candidates are expected to make a statement such as "therefore $(x + 3)$ is a factor of $p(x)$" after showing that $p(–3) = 0$.
- The tangent at a point on a curve has the same gradient as the curve at that point.

Question 1

(a)(i) Almost all candidates began by substituting $x = p$ and $y = p+2$ into the given equation. However, many made a sign error when multiplying out $-4(p+2)$ and consequently $p = 13$ was a very common incorrect answer.

(b) Most candidates rearranged the equation to the form $y=mx+c$ and gave the correct gradient. Some used the coordinates of two points on AB, such as $(1, 2)$ and $(-3, -1)$. Some of the weaker candidates chose two values for p, found 2 pairs of incorrect coordinates and then attempted to find the gradient of the line joining these points.

(c) There were two equally common methods used here. Both required the use of the negative reciprocal of the answer to part (b) to provide the relevant gradient and it was pleasing to note that most candidates realised this. One approach was to find the gradient in terms of k and equate it to the relevant gradient and solve; the alternative was to set up an equation using the coordinates of A (or C) and then to substitute the coordinates of the other point to obtain the value of k.

(d) Although most candidates realised the necessity to set up 2 equations in order to eliminate x or y, arithmetic and sign errors abounded and there were many incorrect solutions. Even those who correctly found $7y = -28$, say, often wrote down an incorrect value of y such as $y = -3$ or $y = 4$. A few candidates misread the question and used an incorrect equation for one of the lines.

Question 2

(a) (i) Most candidates were able to express $\sqrt{48}$ as $4\sqrt{3}$ although a minority then went on to give an answer of $2\sqrt{3}$.

(ii) Candidates who began by writing $\sqrt{12}\times = 2\sqrt{3}\times$ were often successful as they equated this to $7\sqrt{3} - 4\sqrt{3}$ and obtained the equation $2\sqrt{3}\times = 3\sqrt{3}$. However some then subtracted $2\sqrt{3}$ from $3\sqrt{3}$ instead of dividing. A few left their answer as $\frac{3\sqrt{3}}{2\sqrt{3}}$ or "simplified" this to $\sqrt{3}$ either using poor cancellation or subtraction. A few candidates adopted a different approach. They multiplied each side of the equation by $\sqrt{12}$ or $\sqrt{3}$ to obtain an equation in integers. Another alternative approach was to square each side of the equation leading to $12x^2 = 27$. Those who used this method often gave their answer as $\pm\frac{3}{2}$, failing to recognise that their squaring had introduced an extra incorrect solution.

(b) The majority of candidates rationalised the denominator by multiplying the numerator and denominator by $2\sqrt{3} - \sqrt{5}$. It was pleasing to see many correct solutions as candidates were able to cope with the product of $\sqrt{3}$ and $\sqrt{5}$, possibly aided by the form of the printed answer. Once more there were some arithmetic errors; for example, $66 - 10 = 55$ was quite common. The given form of the answer, stating that m was an integer, should have alerted them to an error in their working.

Question 3

(a) Most candidates began by trying to complete the square for both the x terms and the y terms and many were successful. However, several gave the left hand side of the equation for the circle as $(x-5)^2+(y-7)^2$ or $(x+5)^2+(y-7)^2$ and some omitted the plus sign between the squared terms or had a minus sign instead. It was not uncommon to see a negative value on the right hand side of the circle equation and 25 was often seen instead of 49.

(b)(i) This was usually correct, or followed from the candidate`s circle equation.

(ii) Provided the candidate`s value of k in their circle equation was positive, candidates were given credit for stating $\sqrt{k}$ as the value for the radius.

(c)(i) Candidates usually drew a circle where the centre was approximately in the correct quadrant. Less attention was paid to where the circle cut or touched the axes. It was necessary to show the circle touching the x-axis at (5,0) and cutting the negative y-axis twice. A few candidates neglected to draw any axes at all and scored no marks.

(ii) Those who had found the correct centre and radius usually had the correct coordinates. Some simply wrote pairs of coordinates on their circle but often failed to identify the coordinates of the point that was furthest away from the x-axis.

(d) The majority of candidates knew that the transformation was a "translation" although a few included a further transformation such as a "stretch" and some used incorrect words such as "shift". However, very few stated the correct column vector and $\begin{bmatrix}-6\\7\end{bmatrix}$ and $\begin{bmatrix}-6\\-7\end{bmatrix}$ were very common wrong answers.

Question 4

(a) (i) Almost all candidates attempted to find $p(-3)$ and most were successful in showing that $p(-3)=0$. It was pleasing to see many candidates taking heed of previous reports and writing a concluding statement such as "so $x+3$ is a factor". Those who simply used long division were ignoring the request to use the Factor Theorem and earned no marks.

(ii) The majority of candidates used inspection or long division and found the correct quadratic factor. A few using the latter method did not always write their final answer as the product of factors as requested.

(b)(i) Almost all found the first derivative correctly, though a few added "$+\ c$".

(ii) Several candidates presented an inadequate solution here. It was necessary to both equate their answer to part (b)(i) to zero and divided by 4 in order to obtain the given equation.

(iii) Solutions to this part were very disappointing. Most candidates merely substituted $x=-3$ into the given equation and were, in effect, repeating part (a). Those who attempted to solve the quadratic equation or found the value of the discriminant did not always give a satisfactory explanation for the single stationary point of the curve. For example "the discriminant is negative therefore the only real root is $x=-3$".

(iv) Once again the second derivative was found correctly by most, although its value was sometimes incorrect as a result of poor arithmetic, particularly in the evaluation of the term $12\,(-3)^2$. Unfortunately, quite a few candidates divided their expression for $\frac{\mathrm{d}y}{\mathrm{d}x}$ by 4 before differentiating again and wrote $\frac{\mathrm{d}^2y}{\mathrm{d}x^2} = 3x^2 - 4$, which was incorrect.

(v) The interpretation of the sign of the second derivative was well known. However not all candidates gave an adequate reason. A statement such as "$92 > 0$" or "$\frac{\mathrm{d}^2y}{\mathrm{d}x^2}$ is positive" was required; an answer such as "it is positive" or "the value is greater than 0", without specific reference to the value from part (iv), was not sufficient.

Question 5

The majority of candidates failed to answer this question well.

(a)(i) Many candidates were unsuccessful in completing the square as they did not realise the need to take out a factor of 2 first, so $2(x + 3)^2 - 4$ was a common incorrect answer. Many who made the correct approach did not handle the factor of 2 correctly and the expression $2\left(x+\frac{3}{2}\right)^2+\frac{1}{4}$ was seen quite often. Others made sign errors so another common incorrect answer was $2\left(x+\frac{3}{2}\right)^2+\frac{11}{4}$.

(ii) Again there were few correct answers. Many candidates gave the value of *x* for which the expression was a minimum, namely $x=-\frac{3}{2}$. Those who had completed the square correctly often offered a pair of coordinates, namely $\left(-\frac{3}{2}, \frac{1}{2}\right)$, as their answer instead of the minimum value of $\frac{1}{2}$.

(b)(i) Many candidates had no idea how to find the distance between the two points and attempts such as the sum of the products of both *x* coordinates and both *y* coordinates were seen. This may have been due to a lack of understanding of AB^2. Some also interpreted it as $A \times B^2$. Those who began by simplifying $(3x+9-5)^2$, rather than producing an expression with up to nine terms, usually went on to complete the proof successfully. A few made sign errors when subtracting the *y* coordinates, which led to errors. There was some poor squaring such as $(x + 3)^2 = x^2 + 9$, though this did not occur often. It was good to see that almost all included "$AB^2 =$ " in their solution.

(ii) There were very few correct solutions here. Hardly any candidates heeded the instruction of the question to use 5 times their value from part (a)(ii); those who attempted this part often substituted a value for x (usually in the form of a fraction) into $5(2x^2 + 6x + 5)$ and the simplification defeated them. Even some of the most able candidates were unable to change $\sqrt{\frac{5}{2}}$ into the form $\frac{1}{2}\sqrt{n}$.

Question 6

(a) Those candidates who began by finding $\frac{\mathrm{d}y}{\mathrm{d}x}$ usually found the correct gradient and most gave the equation of the tangent in the required form. A few made arithmetic errors such as $y - 6 = 9x + 9$ leading to $y = 9x+3$. A few, having found the gradient to be 9, then incorrectly used the negative reciprocal , i.e. $-\frac{1}{9}$. Some candidates did not realise that differentiation was required and attempted to find the gradient using the coordinates of the two points $(-1, 6)$ and $(2, 33)$.

(b)(i) Provided no arithmetic errors were made, particularly evaluating $2^5 = 64$, then the correct value of k was found from the equation of the curve. A few candidates used the tangent equation and although they found that $k = 33$, no credit was given.

(ii) Those who used the equation of the line did not always earn the mark as a concluding statement such as “therefore lies on the tangent” was not made. Some worked backwards and found the gradient using (2, 33). A few candidates confused the requests in parts (i) and (ii) and consequently earned no marks.

(c)(i) The majority of candidates integrated correctly. Most substituted the limits in the correct order but many sign and arithmetic errors were made. A common error was evaluating $\frac{5}{6} - \frac{54}{6}$ as $\frac{49}{6}$ instead of $-\frac{49}{6}$ and the correct value of the integral was rarely seen.

(ii) Very few candidates found the area of a trapezium. Most found the area of a triangle instead. Those who used integration in order to find the area under the straight line were far more successful than those who tried to remember the basic formula from GCSE.

Question 7

(a) Provided candidates began by writing $b^2 - 4ac \geqslant 0$, and did not write the coefficient of x incorrectly by writing $b = k - 2$ instead of $-(k - 2)$, then full marks were often earned. Some wrote $b^2 = -(k-2)^2$, however, and then conveniently "lost" the minus sign. There were not many sign errors, possibly because the required inequality was given in the question.

(b) There were several completely correct solutions. Those who chose to factorise the equation to find the critical values were usually more successful than those using the quadratic equation formula, as $\sqrt{\left(48^2 - 4\times7\times80\right)}$ defeated many without the use of a calculator. Candidates are advised to draw a sketch or sign diagram in order to solve a quadratic inequality. Some gave their final answer as $k \leqslant 4, \quad k \geqslant \frac{20}{7}$ or $\frac{20}{7} < k < 4$, both of which were penalised by one mark.

Mark Ranges and Award of Grades

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

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UMS conversion calculator www.aqa.org.uk/umsconversion