Version 1.0

General Certificate of Education (A-level)
January 2012

Mathematics MPC1

(Specification 6360)

Pure Core 1

Report on the Examination

Set and published by the Assessment and Qualifications Alliance.

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Registered address: AQA, Devas Street, Manchester M15 6EX.

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 and rationalising the denominators of surds. When an answer, such as the equation of a straight line, is requested in a particular form, candidates will not score full marks if their final line is not in the required form. Careful attention needs to be given to proofs when a printed answer is given: the final line of working should match the printed answer. Several examiners commented on the many arithmetic errors, particularly in dealing with negative signs and fractions. Poor algebraic manipulation was evident in factorising quadratic expressions and when solving simultaneous equations. 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.
- If the remainder is R when $\mathrm{p}(x)$ is divided by $x + 3$, then $\mathrm{p}(-3) = R$.
- A quadratic equation has equal roots when the discriminant is equal to zero ($b^2 - 4ac = 0$).
- A sign diagram or a sketch showing the critical values might be helpful when solving a quadratic inequality.

Question 1

In part (a), almost everyone recognised the need to use the distance formula, though a few were unable to calculate 49 + 4 successfully. Many candidates scored full marks for correct working and a correct summary statement. Those who failed to write a correct conclusion involving the lengths OA and OB lost the final mark. Several candidates confused OA^2 with OA, writing things like $OA^2 = 6^2 + (-4)^2 = \sqrt{52}$, which again was enough to lose the final mark. A minority of candidates used an incorrect formula for the distance between two points, such as $OA = \sqrt{36-16} = \sqrt{20}$ and scored no marks at all.

In part (b)(i), apart from a few sign errors, most candidates obtained the correct gradient. Some wrote the gradient as "difference in x values / difference in y values" and so did not score any marks.

In part (b)(ii), most candidates wrote down a correct form of the equation, such as $y - -4 = \frac{-11}{8}(x - 6)$. However, careless arithmetic prevented many from obtaining the final equation in the required form with integer coefficients. Those who used $y = mx+c$ often only earned a single mark for having the correct gradient, as they never had a correct form of the equation.

In part (c), most candidates realised that the product of the gradients of perpendicular lines should be –1 and wrote the perpendicular gradient as $\frac{8}{11}$. Many made little progress beyond this point; some used the coordinates of B instead of A; others used the correct method but combined 44 and 48 incorrectly to give 82, or even – 4. Full marks were given for giving an answer as a fraction not reduced to its simplest form.

Question 2

In part (a), the factorisation was almost always correct. Perhaps because of a confusion between factors and roots, many solved an equation in this part to give $x = -2$ and $x = 6$. This was considered as further non-contradictory work and was not penalised.

In part (b), the most common score for the graph was 3 marks. A large number of candidates who had the correct x-intercepts drew a distorted parabola, which had a minimum at $(0, -12)$. Some were quite happy to mark the intercepts as $(-2, 0)$ and $(6, 0)$ but then drew a curve with these intercepts equidistant from the origin.

In part (c)(i), many candidates were familiar with the technique of completing the square, although quite a few gave their answer as $(x-2)^2 - 8$ instead of $(x-2)^2 - 16$.

In part (c)(ii), most candidates offered the coordinates of the minimum point of a curve, writing $(2,-16)$ as their answer, instead of giving **the minimum value of the expression**. Sadly, many did not return to part (b) to correct their graphs so as to illustrate this correct minimum point.

Part (d) was beyond the understanding of most candidates. A very common incorrect answer was $y = (x+3)^2 + 2$. Some gained a mark for adding 2 to their quadratic (or for replacing y by $y - 2$) but many also replaced x by $x - 3$ instead of $x + 3$. Quite a number of those who used the correct approach did not actually write down **an equation**, forgetting to include "$y =$ ", and so lost the final mark.

Question 3

In part (a) (i), many candidates misinterpreted $\left(3\sqrt{2}\right)^2$ as $\left(3+\sqrt{2}\right)^2$ and these candidates often used a grid method to obtain $11+6\sqrt{2}$. Others gave the value as 36, but the correct answer was seen quite often.

In part (a)(ii), a few weak candidates ignored the terms in $\sqrt{2}$ and wrote $18 + 1 + 9 + 2 = 30$, which earned no marks. This is a warning to candidates that getting the correct answer by an incorrect method will not be given any credit. Multiplication of surds caused some problems: $\left(\sqrt{2}\right)^2$ was often seen evaluated as 4 instead of 2, and the arithmetic error $1\times1 = 2$ was seen quite a few times. Nevertheless, there were several correct solutions.

In part (b), once again, poor arithmetic led to errors such as $20 - 2 = 16$ and $40 + 14 = 56$. Most recognised the first crucial step of multiplying the numerator and denominator by $2\sqrt{5}-\sqrt{2}$ and many obtained $\dfrac{54-18\sqrt{5}\sqrt{2}}{18}$, but then incorrect evaluation of the numerator or poor cancellation led to many failing to obtain the correct final answer. Some were unable to cope with the product of $\sqrt{5}$ and $\sqrt{2}$, which became $\sqrt{7}$ for example.

Question 4

In part (a), differentiation had been well drilled and most candidates earned all 4 marks for the two derivatives. Occasionally, the $+1$ was omitted or an extra 5 or $+x$ was included, and a few felt the need to add $+c$ to both their answers.

In part (b), those candidates who substituted $x = -1$ into their expression for $\frac{dy}{dx}$ often obtained a gradient of 12. However, not all used this value: some took the negative reciprocal and then formed the equation of the normal. Some candidates did not use their expression for $\frac{dy}{dx}$ in order to find the gradient but erroneously used the gradient of AB, with value 2, instead.

Surprisingly, a very small minority earned full marks in part (c). Most candidates verified the nature of the stationary point by considering the sign of the second derivative. However only a handful recognised the need to verify that the point was stationary in the first place, by showing that the first derivative was equal to zero.

In part (d)(i), most candidates were able to integrate the expression, with only the weakest candidates not making any attempt. Poor notation was used, with many including the integral sign after integrating. However dealing with the substitution of –1 caused many errors. Manipulation of fractions caused problems too; it was disappointing to see many candidates with correct fractions being unable to combine these to give a value of 8 or equivalent. Many candidates did not find the actual value of the definite integral until part (d)(ii), and on this occasion full credit was given, but this may not be the case in future.

In part (d)(ii), most candidates calculated the area of the relevant triangle to be 2 and subtracted this from their answer to part (d)(i). Errors included writing the area of the triangle as $\frac{4\times 2}{2}$ and careless arithmetic such as $8 - 2 = 4$.

Question 5

Many weaker candidates floundered in this question as they did not recognise the need to use the Remainder and Factor Theorems.

In part (a), most began by finding $\mathrm{p}(-2)$ and correctly equated this to -150. Some ignored the minus sign and so could not complete the proof. Some sign and arithmetic errors were seen, and yet, uncannily, the printed answer appeared on the final line of working. Those who tried long division were usually unsuccessful as the algebra proved too difficult for most.

In part (b), with the value of x being positive here, fewer errors occurred when finding $\mathrm{p}(3)$, but 3^3 was often written as 9. Quite a few neglected to equate $\mathrm{p}(3)$ to zero; some candidates equated $\mathrm{p}(3)$ to -150, confusing parts (a) and (b).

In part (c), many who found the correct simultaneous equations were incapable of solving them. Although two equations were often formed with the same coefficients of x or y, they were then added when subtraction was applicable and vice versa. Signs were often lost, and arithmetic was poor once again. Correct answers were only obtained by the very best candidates.

Question 6

In part (a), the simple inequality was not always obtained; many tried to work backwards from the answer, and several confused perimeter and area.

In part (b), once again many tried to work backwards from the printed answer and omitted the vital step of writing the area as $x(x + 4)$, which had to be less than 96.

In part (c), generally factorisation of the quadratic was done well; however, a few wrote $(x – 12)(x + 8)$ as their factorised form. Those who wrote down an incorrect answer without working usually only scored marks for the critical values. Candidates are strongly advised to draw a sketch or sign diagram.

It was very rare to see a correct answer to part (d), with the majority of candidates not considering the condition $x > 5.5$. Many simply wrote down the inequality $–12 < x < 8$ again. One common misconception was that the possible values of the width of the garden had to be integers. Some gave 6 and 7 as their answer, while many listed all the integers from –12 to + 8.

Question 7

In part (a), most candidates were able to complete the square for at least one of the terms. A very common incorrect answer involved $(x – 7)^2$ instead of $(x + 7)^2$. Occasionally a negative answer was given for the square of the radius. Also, $\sqrt{5}$, $\sqrt{25}$ and ± 49 were often seen on the right-hand side of the equation.

In part (b), the coordinates of the centre usually followed through correctly from part (a). Often the correct radius was stated, even though part (a) was incorrect.

In part (c), the centre of the circle usually appeared in the correct quadrant for the candidate's coordinates. However, those who had the correct answers in part (b) did not always draw the correct circle touching the x-axis at –7 and not touching the y-axis.

In part (d)(i), several candidates earned the method mark but the most common error lay in the failure to square (kx) as k^2x^2; most wrote kx^2 and immediately lost the accuracy mark.

In part (d)(ii), candidates seemed to think it necessary to write "= 0" only on the very last line. This does not fulfil the requirements of a proof. The first line should be that equal roots occur when $b^2 – 4ac = 0$ and the "= 0" should continue throughout.

Other common errors occurred in the squaring of $2(k + 7)$, which often became $2(k + 7)^2$. Candidates should check each line of their proof instead of fudging one or more lines of working, as examiners are unlikely to be deceived by the miraculous appearance of the printed answer following incorrect working.

Many did not attempt part (d)(iii). The factorisation of the quadratic expression defeated most candidates; too many are reliant on the quadratic equation formula which often produces large numbers that are difficult to handle without a calculator. The incorrect factors $(4k – 3)(3k + 4)$ were seen as often as the correct ones. Candidates found this factorisation extremely hard and very few picked up these two final marks, but this is a topic that should not be beyond students at this level.

Mark Ranges and Award of Grades

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