Version : 1.0 0609

General Certificate of Education

Mathematics 6360

MPC1 Pure Core 1

Report on the Examination

2009 examination - June series

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Set and published by the Assessment and Qualifications Alliance.

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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 and completing the square. 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 tangent to a circle with centre C at the point *A* is perpendicular to the straight line which passes through C and A.
- When asked to use the Factor Theorem, no marks can be earned for using long division.
- When using the factor theorem, it is not sufficient to show that $\mathrm{p}(-2) = 0$. A statement such as "therefore $x + 2$ is a factor" should appear.
- The value of $\int_a^b \mathrm{f}(x)\,\mathrm{d}x$ is found by evaluating $\mathrm{F}(b) - \mathrm{F}(a)$ where $\mathrm{F}(x)$ is the integral of $\mathrm{f}(x)$.
- The least value of $(x - p)^2 + q$ is q and occurs when $x = p$.
- A quadratic equation has two distinct real roots when the discriminant is greater than zero ($b^2 - 4ac > 0$) and has no real roots when the discriminant is less than zero ($b^2 - 4ac < 0$).

Question 1

In part (a)(i) many candidates were unable to make *y* the subject of the equation $3x + 5y = 11$ 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.

In part (a)(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)(i).

Although many correct answers for the coordinates of C were seen in part (b)(i), the simultaneous equations defeated a large number of candidates. No credit was given for mistakenly using their equation from part (a)(ii) instead of the correct equation for AB.

Question 2

In part (a) most candidates recognised the first crucial step of multiplying the numerator and denominator by $3 + \sqrt{7}$ and many obtained $\dfrac{22 + 8\sqrt{7}}{2}$, but then poor cancellation led to a very common incorrect answer of $11 + 8\sqrt{7}$.

Candidates found part (b) more difficult than part (a) and revealed a lack of understanding of surds. Most candidates realised the need to use Pythagoras' Theorem but many could not square $2\sqrt{5}$ and $3\sqrt{2}$ correctly. Little credit was given for those who wrote things such as $x = \sqrt{20} - \sqrt{18} = \sqrt{2}$ and candidates need to realise that "getting the right answer" is not always rewarded with full marks. Although the equation $x^2 = 2$ has the solution $x = \pm\sqrt{2}$, it was necessary to consider the context and to give the value of x as $\sqrt{2}$.

Question 3

In part (a) almost everyone obtained the correct expression for $\frac{dy}{dx}$, although a few spoiled their solution by dividing each term by 5 or adding "+ c" to their answer.

In part (b) most candidates substituted $x = -2$ into their expression for $\frac{dy}{dx}$, but, in order to score full marks, it was necessary to show $(-2)^4$ written as 16 or to show that $\frac{dy}{dx} = 80 - 80 = 0$ and then to write an appropriate conclusion about P being a stationary point.

For part (c) many candidates simply wrote down an expression for $\frac{d^2y}{dx^2}$ in terms of x when answering part (i) and only evaluated the second derivative when determining the nature of the stationary point in part (ii). On this occasion full credit was given, but candidates need to realise what is meant by the demand to "find the value of" since this may be penalized in future examinations.

In part (d) some candidates failed to find the y-coordinate of P, which was necessary in order to find the equation of the tangent. It was pleasing to see most candidates using the value of $\frac{dy}{dx}$ when $x = 1$, but unfortunately many tried to find the equation of the normal instead of the tangent to the curve.

Question 4

Those candidates who used the remainder theorem in part (a)(i) were usually successful in finding the correct remainder. Those who tried to use long division were usually confused by the lack of an x^2 term and were rarely successful in showing that the remainder was 30.

Those who used long division in part (a)(ii) scored no marks. Most candidates realised the need to show that $p(-2) = 0$, but quite a few omitted sufficient working such as $p(-2) = -8 + 2 + 6 = 0$ together with a concluding statement about $x + 2$ being a factor and therefore failed to score full marks.

Many candidates have become quite skilled at writing down the correct product of a linear and quadratic factor and these scored full marks in part (a)(iii). Others used long division effectively but lost a mark for failing to write $p(x)$ in the required form. Others tried methods involving comparing coefficients, but often after several lines of working were unable to find the correct values of b and c because of poor algebraic manipulation.

In part (a)(iv), although many candidates tried to consider the value of the discriminant of their quadratic factor, quite a few used $a = 1$, $b = -1$ and $c = 6$ (from the cubic equation) and scored no marks for this part of the question. Others drew a correct conclusion using the quadratic equation formula, indicating that it was not possible to find the square root of -8 and others, after completing the square showed that the equation $(x-1)^2 = -2$ has no real solutions. Some wrongly concluded that because it was not possible to factorise their quadratic then the corresponding quadratic equation had no real roots.

Most obtained the correct y-coordinate of B in part (b)(i).

In part (b)(ii) it was pleasing to see most candidates being able to integrate correctly but a large number did not answer the question set and simply found the indefinite integral in this part. Many candidates use poor techniques when finding a definite integral and it was often difficult to see the evaluation of $\mathrm{F}(0) - \mathrm{F}(-2)$ in their solution. Many obtained an answer of -10 which was miraculously converted into $+10$ with some comment about an area being positive. This and similar dubious working was penalized.

In part (b)(iii) some obtained an answer of -6 for the area of the triangle by using -2 as the base. Credit was given to candidates who later realised that the area of the triangle was actually 6. Unless candidates had scored full marks in part(ii) they were not able to score full marks in this part either, even if they obtained a correct value of 4 for the shaded area.

Question 5

In part (a)(i) most candidates realised what the correct coordinates of the centre were, although some wrote these as $(-5, 12)$ instead of $(5, -12)$.

Some gave the radius as 169 and others evaluated $\sqrt{169}$ incorrectly in part (a)(ii). The majority of candidates obtained the correct value of the radius.

In part (b)(i) most were able to verify that the circle passed through the origin, although some neglected to make a statement as a conclusion to their calculation and so failed to earn this mark. A surprisingly large number made no attempt at this part.

Most sketches were correct in part (b)(ii), though some were very untidy with some making several attempts at the circle so the diagram resembled the chaotic orbit of a planet. In spite of being asked to verify that the circle passed through the origin many sketches did not do so. Credit was given for freehand circles with the centre in the correct quadrant and which passed through the origin, although it was good to see some circles drawn using compasses. Many used algebraic methods, putting $x = 0$, but often their poor algebra prevented them from finding the value of p. Those using the symmetry, doubling the *y*- coordinate, were usually more successful, although an answer of -25 $(\text{from } -12-13)$ was common.

In part (c)(i) the majority of candidates tried to find the gradient of AC but careless arithmetic meant that far fewer actually succeeded in finding its correct simplified value.

In part (c)(ii), in order to find the tangent, it was necessary to use the negative reciprocal of the answer from part (c)(i) in order to find the gradient. Although some did, many chose to use the same gradient obtained in the previous part of the question and scored no marks at all.

Question 6

Completing the square was done well by most candidates in part (a)(i), although quite a few wrote *q* as 17 instead of 1.

Part (a)(ii) of this question was answered very badly with many giving their answer as coordinates. Candidates were either “hedging their bets” or were simply presenting the coordinates of a minimum point of a curve as their answer.

In part (a)(iii) many candidates obtained the correct value for x in this part, but there was confusion with many about how to answer parts (i) and (ii). The question was deliberately designed to test the understanding of the minimum value of a quadratic expression and when this occurred. Those who wrote "(ii) 4 and (iii)1" scored no marks at all for these two parts of the question.

In part (b)(i) practically everyone scored a mark for multiplying out $(x - 5)^2$ correctly.

In part (b)(ii) only the best candidates obtained a correct expression for AB^2 and then completed the resulting algebra to obtain the printed answer.

It was good to see that many saw the link between the various parts in part (b)(iii). Many more able candidates substituted $x = 4$ into the expression and obtained $AB^2 = 2$, but they then failed to take the positive square root in order to find the minimum distance.

Question 7

Most candidates scored the mark for the correct printed equation in part (a), but some omitted "$= 0$" and others made algebraic slips when taking terms from one side of their equation to the other.

In part (b)(i) only the more able candidates were able to obtain the printed inequality using correct algebraic steps. Many began by stating that the discriminant was less than 0, clearly being influenced by the answer. Not all assigned the correct terms to a, b and c in the expression $b^2 - 4ac$ and others made sign errors when removing brackets.

The factorisation was usually correct in part (b)(ii), but many wrote down one of the critical values as $\frac{1}{3}$. 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 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.