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Mathematics MPC1

(Specification 6360)

Pure Core 1

Report on the Examination

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General

This was the first time that MPC1 had been marked online and many candidates did not heed the instruction to write in black ink, thus sometimes causing problems for examiners relating to reading the work. It is now even more important that candidates set out their work neatly and legibly and use the booklet provided for all their working. When extra sheets are handed out, candidates should be advised to cross through any rough work that they do not want to be marked.

The question paper seemed to provide a good challenge for able candidates whilst at the same time allowing weaker candidates to demonstrate their understanding of differentiation and integration and basic coordinate geometry. Algebraic manipulation, particularly when candidates do not use brackets correctly, remains a weakness and the number of arithmetic errors, for instance when combining fractions, suggested that some candidates have become too dependent on a calculator for simple arithmetic.

Certain questions contain words such as “show that” or “verify” and these requests are sometimes treated too casually. Candidates need to recognise that each line of a proof needs to be mathematically correct in order to earn full marks. When a printed answer is given, this precise form must be seen as a final equation or expression in the candidate’s work. If a question asks for a particular result to be proved or verified then an appropriate concluding statement is usually required; a “tick” or QED is insufficient.

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 $y = mx + c$;
- 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;
- When asked to use the Factor Theorem, candidates 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 equation of the line of symmetry of the quadratic curve with equation $y = a + b(x + c)^2$ is $x = -c$;
- Parallel lines have the same gradient;
- The tangent to a curve at the point P has the same gradient as the curve at the point P;
- The tangent at a point D to a circle with centre C is perpendicular to the straight line which passes through C and D.

Question 1

Part (a) It was good to see almost everyone being able to differentiate correctly. A few then went on to divide their expression for $\frac{\mathrm{d}y}{\mathrm{d}x}$ by 2 or 3 or 6, but this was not penalised at this stage.

Part (b) Most candidates tackled the verification that P was a stationary point first and generally did so correctly, although some did not present accurate working, writing things such as 18 + 6 −12 = 0. Many stopped at this point, although a few tried listing various values of x with the corresponding value of $\frac{\mathrm{d}y}{\mathrm{d}x}$, and occasionally discovered the other value of x for which y was stationary. Many candidates equated $\frac{\mathrm{d}y}{\mathrm{d}x}$ to zero, but not all were then able to factorise the quadratic correctly. Some felt the need to use the quadratic equation formula and were not always successful in finding the correct solutions.

Part (c)(i) Those who had the correct expression for $\frac{\mathrm{d}y}{\mathrm{d}x}$ usually found the second derivative correctly. Many ignored the request to find the value of $\frac{\mathrm{d}^2y}{\mathrm{d}x^2}$ when $x = -1$, but this was sometimes generously credited in part (c)(ii), where it was pleasing to see most candidates being able to interpret the sign of the second derivative in order to describe the nature of the stationary point.

Question 2

Part (a) This part was answered surprisingly badly, even though in some cases $\left(3\sqrt{3}\right)^2$ was then correctly computed in part (b). Those who relied on some sort of grid method fared particularly badly.

Part (b) It was good to see that almost everyone was able to use a correct conjugate; the most common error was multiplying numerator and denominator by $3\sqrt{3}-7$. Most candidates then went on to earn the further method mark, though a few did not combine $\sqrt{3}\times\sqrt{7}$ to make $\sqrt{21}$ and others could not simplify $\sqrt{7}\times\sqrt{7}$ etc. A large number of candidates did all the correct working but did not simplify $\frac{15+5\sqrt{21}}{20}$ to earn the final mark.

Question 3

Part (a)(i) Although the majority of candidates found the correct gradient, some lost the – sign and others wrote their answer as $-\frac{3}{2}x$. Those who used two correct points often made a sign error in simplifying their expression for the gradient.

Part (a)(ii) It was disconcerting to see so many candidates finding the equation of a line perpendicular to AB rather than the equation of a line parallel to AB. Even having the correct line equation did not mean that full marks were earned; quite a few found the value of x when $y = 0$ and others who correctly obtained the equation $3x + 2y + 8 = 0$ quoted the intercept as being at $y = -8$.

Part (b) This was generally well done, although eliminating y and getting as far as $5x = -5$ did not always result in the correct solution; final answers of $x = -5$ or $x = 1$ were seen far too often.

Part (c) The relevant distance formula expression often had a sign error in at least one bracket or was equated to 5 instead of 25. However it was good to see a sizeable number of fully correct solutions. Some candidates used a diagram and a vector approach and wrote down the correct values of k.

Question 4

Part (a)(i) Candidates who recognised that the first step required was differentiation generally produced correct answers, but a few had trouble with the "$-x$" term and others were unable to combine $-1 + (-4)$ correctly. Some weaker candidates assumed that they could find the gradient using the coordinates of two points.

Part (a)(ii) Once again there was much confusion between parallel and perpendicular lines, with many candidates giving the wrong gradient of the tangent. To earn the final mark it was essential to express the equation in the specified form and some failed to do so; for instance, an answer such as $y + 5x = 17$ is not in the correct form.

Part (b)(i) The integration here was generally correct and most candidates made an attempt to substitute the correct limits. A few however could not integrate "14" and left it as a constant. Very few were able to combine their fractions correctly and consequently only a small proportion of the candidates found the correct value of the integral.

Part (b)(ii) Candidates who had only found the definite integral in part (b)(i) were generously rewarded with the remainder of the marks here. Not everyone recognised the need to find the area of a triangle in order to find the area of the shaded region. A few correctly found the area under the line $y = 4x + 8$ by integration, but this is not the recommended approach.

Question 5

Part (a)(i) This part was quite often not attempted. Many candidates did not recognise the equation as that of a cubic and drew a parabola. Some drew the graph of $y = x^3$ with a stationary point of inflection but this scored no marks. The majority of candidates drew a cubic curve with a maximum point and a minimum point, but often these points were in the wrong place. Often those whose curve touched the x-axis at $x = 2$ did not draw their curve through the origin.

Part (a)(ii) Many candidates failed to score the mark here because of a variety of algebraic errors, often involving signs or a failure to write = 0 at the end of lines of working.

Part (b)(i) Most realised the need to find p(–1) and not p(1). However, a few candidates did make an arithmetic error and sadly quite a few did obtain p(–1)= –12 but then proceeded to say that the remainder was 12. Those who tried long division often made algebraic errors; those with correct working needed to extract the remainder and make a statement.

Part (b)(ii) The factor theorem was also well done but the necessary statement about $(x - 3)$ being a factor was occasionally missing. It was good to see only a few solutions using long division as they were given no credit for an incorrect method.

Part (b)(iii) The factorisation here was generally correct, and given in the required form. Many candidates were able to write down the quadratic factor by inspection.

Part (c) The more able candidates coped well with this part, establishing the value of the discriminant $(b^2 - 4ac)$ for the quadratic factor and explaining that the value of –3 was negative and hence the quadratic equation had no real roots. Equally acceptable was an attempt to solve the equation and to comment about the negative value under the square root sign. The mark for identifying the real root as being 3 was earned by many but not by those who said that the root was $(x - 3)$ or other incorrect statements. Some weaker candidates wrongly tried to find the value of the "discriminant" using the coefficients of the cubic equation.

Question 6

Part (a)(i) The LHS of this equation was almost always correct but the RHS was less commonly so with $\sqrt{13}$ or 13^2 being common wrong answers.

Part (a)(ii) Again, the first 4 terms, namely $x^2 + y^2 + 6x - 4y$, were generally correct with just the odd slip occurring, either in a sign or perhaps from not doubling one of the x or y coefficients. The rest of the equation was only completed correctly by about half of the candidates, although some managed to recover from an error in their equation in part (a)(i), usually replacing $\sqrt{13}$ by 13.

Part (b) This part defeated many candidates. Using algebra, putting $x = 0$ and solving the quadratic to find the y- intercepts, and hence finding the length of AB, was done only by the most competent. However some candidates were successful using a diagram and the theorem of Pythagoras. Unfortunately some who drew a picture assumed that the two radii to the intercepts were at right angles and their Pythagoras calculations were incorrect.

Part (c)(i) This proved an insurmountable hurdle for those who tried to use their wrong circle equation; fortunately those who used the form given in the question were more likely to be successful. Some compared the distance from the point to the centre of the circle with the radius, but, in many cases, there was some confusion between 13 and $\sqrt{13}$ and these candidates lost the mark. Unfortunately some also lost the mark by failing to complete their verification with a relevant statement.

Part (c)(ii) This was the only place in this question paper where it was essential to know how to find the gradient of the line joining two points. A few candidates had their expression upside down; however many who wrote down a correct expression for the gradient were often unable to cope with the negative signs when simplifying their gradient into a simple fraction.

Part (c)(iii) The tangent to the circle required the negative reciprocal of the gradient of *CD* to be calculated, since a perpendicular line was involved, but many seemed unaware of this procedure.

Question 7

Part (a)(i) The negative coefficient of x^2 confused many candidates. The correct answer was rarely seen. Those who chose to work initially with the negative of the given expression, even successfully finding $(x+5)^2-29$, often wrote their final answer as $29-(x-5)^2$. Candidates need to practise completing the square for expressions of this type even though it has not previously been tested very often.

Part (a)(ii) Too many had no idea how the line of symmetry related to the previous part. Many candidates just wrote down the maximum point or the equation of the parabola.

Part (b)(i) Although the majority of candidates realised that they should equate the two equations, numerous algebraic errors appeared before the final line and even this final equation was sometimes incorrect.

Part (b)(ii) Even some able students were unable to cope with squaring $2(2k+5)$ in order to find an expression for the discriminant. Again, poor algebra and fudging abounded in order to obtain the printed inequality. To earn all the marks it was essential to have stated the condition $b^2-4ac>0$ early in their working.

Part (b)(iii) Only correct factors or quadratic formula earned the first mark here; candidates at this level should all be capable of this, particularly with 29 being a prime number. Unfortunately, even with correct factors, some lost the minus sign on one of their critical values. Many failed to draw the appropriate sketch or sign diagram for determining the correct solution, and a few lost the final mark by trying to combine the two correct inequalities thus producing an intransitive statement such as $-\frac{29}{4}>k>-1$.

Mark Ranges and Award of Grades

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