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Mathematics MPC1

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Pure Core 1

Report on the Examination

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General:

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 or by use of the formula need more attention by weaker candidates. Algebraic manipulation continues to be a weakness and the number of arithmetic errors suggested that some candidates have become too dependent on a calculator for simple arithmetic. 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 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 line of symmetry of the parabola $y = (x + p)^2 + q$ has equation $x = –p$;
- When asked to use the Factor Theorem, candidates are expected to make a statement such as “therefore $(x +1)$ is a factor of $p(x)$” after showing that $p(–1) = 0$;
- The tangent at the point A to a circle with centre C is perpendicular to AC

Question 1

Part (a) Most candidates were able to find the correct gradient; however, some were unable to make y the subject of the equation $7x + 3y = 13$.

Part (b)(i) The most successful attempts at the equation of the line used an equation of the form $y–y_1=m(x–x_1)$ as flagged above. Many who tried to use $y = mx + c$ lost a mark because they made arithmetic errors when trying to find the value of c. Unfortunately, some candidates used the gradient of the line perpendicular to AB.
Part (b)(ii) Many candidates used a method based on differences of coordinates or simply wrote down the correct coordinates of A, but others misunderstood the request and actually found the mid-point of A and the given point.

Part (c) Most candidates made an attempt at the simultaneous equations but it was alarming to see how few obtained the correct solutions. Poor algebraic skills and carelessness were often evident here; elimination of one of the variables proved to be the most successful approach; those using substitution were usually unable to cope with the fractions. No credit was given to candidates who used the wrong pair of equations.

Question 2

Part (a)(i) The term $\sqrt{48}$ was usually expressed as $4\sqrt{3}$ although many left their answer as $2\sqrt{12}$

Part (a)(ii) Those who multiplied by $\frac{\sqrt{12}}{\sqrt{12}}$ made little progress. The most successful used the hint from part (i) and expressed each term in the form $k\sqrt{3}$; many who obtained $\frac{10\sqrt{3}}{2\sqrt{3}}$

believed that this simplified to $5\sqrt{3}$. Consequently, the final correct answer was only obtained by the better candidates.

Part (b) It was pleasing to see that most candidates were familiar with the technique for rationalising the denominator and, although there were some who made slips when multiplying out the two brackets in the numerator, most obtained the correct answer in the given form. Once again, some candidates cancelled incorrectly and thus did not obtain the correct final answer.

Question 3

Part (a) Finding $\frac{\mathrm{d}V}{\mathrm{d}t}$ caused few problems apart from those who chose to multiply by 4 before differentiating. Some will insist on adding +*c* to their derivative despite advice given in previous reports.

Part (b)(i) The concept of "rate of change" seemed to be better understood this time, helped by there being only one derivative to choose from; careless arithmetic when trying to simplify $0.75 - 3$ spoiled many solutions.
Part (b)(ii) Most candidates realised that the volume was decreasing when $t = 1$ but many failed to give an adequate reason; most neglected to state the crucial fact that the rate of change was negative.

Part (c)(i) Candidates were expected to solve an equation of the form $\frac{3}{4}t^2 - 3 = 0$ but most chose to guess that $t = 2$ was the solution and attempted to verify this fact.
Part (c)(ii) Once again the explanation as to why the stationary value was a minimum value was inadequate, very often taking no account of the value of *t* found in the previous part of the question. Some candidates who correctly found that the second derivative was $\frac{3t}{2}$ and proceeded to solve the equation $\frac{3t}{2} = 0$ often obtained a value such as 6 and stated that this positive solution indicated a minimum value.

Question 4

Part (a) The coefficient of x, this time being an odd number, caused many problems in the completion of the square; most candidates could not square 2.5 without a calculator and those who used fractions could not always simplify $7 - \frac{25}{4}$.

Part (b)(i) Most candidates realised that the vertex was the minimum point but failed to see the link with part (a) and hence were seldom able to write down the correct coordinates. A few were successful using differentiation, but even when the x- coordinate was correct, they often made arithmetic slips in finding the y-coordinate of the vertex.
Part (b)(ii) The equation of the line of symmetry was not usually correct with many writing down the equation of a curve rather than a straight line; the incorrect wrong equation $y = -\frac{5}{2}$ was seen very often.
Part (b)(iii) Those with the correct minimum point were usually able to produce a correct sketch, although the value of the y-intercept was sometimes missing from good sketches. Some credit was given to candidates with an incorrect minimum point provided their graph was consistent with this minimum point.

Part (c) Only the very able candidates who had answered part (a) correctly earned full marks here. The term **translation** was required but generally the wrong word was used or it was accompanied by another transformation such as a stretch (even though this transformation is not within the MPC1 specification). A very common (but incorrect) vector stated by candidates was $\begin{bmatrix}5\\7\end{bmatrix}$, as once again many failed to realise the significance of part (a).

Question 5

Part (a) Many candidates believe that long division or some other synthetic division is what is meant by the Remainder Theorem. Teachers are well advised to try to remove this illusion from candidates or they will continue to score no marks for using an inappropriate method. A common wrong answer came from "$27–18+3 = 27–21 = 6$" and others thought that the remainder was given by $\text{p}(-3)$.

Part (b) Most candidates realised the need to find the value of $\text{p}(x)$ when $x = –1$. However, it was also necessary, after showing that $\text{p}(–1) = 0$, to write a statement that the zero value implied that $x +1$ was a factor. It is encouraging to see an increasing number of candidates being more aware of this. Some evaluated $\text{p}(1)$ and scored no marks.

Part (c)(i) Those who used inspection were the most successful here; methods involving long division or equating coefficients usually contained algebraic errors.
Part (c)(ii) Most candidates realised the need to consider the discriminant but several used the coefficients of the original cubic rather than those of the quadratic. Having shown that the value of the discriminant was negative it was necessary to state that the quadratic had no real roots and so the cubic had exactly one real root namely $–1$.

Question 6

Part (a) Most candidates were well drilled in integration and earned the first three marks; however, the fractions caused tremendous problems to most candidates who were simply incapable of evaluating $\left(\frac{1}{4}-\frac{2}{3}+3\right)-\left(\frac{1}{4}+\frac{2}{3}-3\right)$ without a calculator. Consequently, an incredibly small percentage obtained the correct value for the integral.

Part (b) The area of the triangle was usually found to have value 2 , although quite a few could not simplify $\frac{2\times 2}{2}$, and most candidates scored a mark for subtracting the area of the triangle from their answer to part (a). Only the best candidates found the correct value for the shaded region.

Question 7

Many candidates ignored the inequality signs throughout this question.

Part (a) The linear inequality defeated many whose algebra was weak; multiplying out brackets is a skill that all AS-level candidates should have mastered before starting a more advanced course, but sadly this often is not the case. It was quite alarming to see the low success rate in this part of the question, with most candidates removing the brackets and writing $8 – 6x > 5 – 4x + 8$ and consequently scoring no marks. Those candidates who obtained $–2x > –11$ were seldom able to obtain the correct final inequality, forgetting to change the $>$ sign.

Part (b) The slightly unusual way in which the quadratic inequality was presented did faze a few, but most candidates found the correct critical values. Perhaps more candidates would be successful in solving quadratic inequalities if they were to draw a sign diagram or sketch a graph. Admittedly, bright candidates are able to write down the correct solution with little or no working, but quite a few spoiled a correct solution by writing their final answer as $1.5 \leqslant x \leqslant -4$.

Question 8

Part (a) Most candidates found the correct values of a and b, but correct values for k were not so common. Some sloppiness was again evident with candidates failing to write squared outside the brackets or omitting the plus sign between the terms on the left hand side.

Part (b) Some used an approach based on Pythagoras, but the majority of candidates used an algebraic method, substituting $y = 0$ into their circle equation and solving the resulting quadratic equation in x. Although there were a number who made sign errors, many candidates produced the correct values of x. Nevertheless, common mistakes such as putting $x = 0$ or $(y+8) = 0$, instead of $y = 0$, resulted in no marks being earned.

Part (c) Many candidates assumed that the gradient of CA was 2.5 instead of finding the negative reciprocal and many who did have a correct equation were unable to produce an equation with integer coefficients as requested. A sketch might have helped some to have seen the correct configuration and perpendicularity.

Part (d)(i) Most candidates realised the need to substitute $y = 2x + 1$ into one or other form of their circle equation but algebraic errors abounded as they tried to produce the displayed quadratic equation. Those who expanded the circle equation first were generally more successful; others who did not have 100 on the right hand side of their circle equation failed to recognise this error when they failed to produce the printed answer for the equation. Candidates should be strongly discouraged from starting each new line with an equals sign when producing an algebraic proof of this type that involves equations.
Part (d)(ii) Those who completed the square failed to score full marks if they simply wrote $x + 3 = \sqrt{11}$ before concluding that $x = -3 \pm \sqrt{11}$. Those using the quadratic equation formula often struggled to simplify $\dfrac{-6 \pm \sqrt{44}}{2}$.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results statistics page of the AQA Website. UMS conversion calculator www.aqa.org.uk/umsconversion