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Mathematics 6360

MPC1 Pure Core 1

Report on the Examination

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General

It was pleasing to see that many candidates were well prepared for this unit. On the whole presentation was quite good, but algebraic manipulation remains a weakness. The different form of some of the questions confused some of the weaker candidates. Many did not recognise the main features of graphs of straight lines, parabolas or cubics.

Those being prepared for future examinations might benefit from the following advice.

- When sketching a straight line, the intercepts on the *x*-axis and y-axis need to be found and marked on the axes, and, even though the word "sketch" may be used, it is a good idea to use a ruler.
- When asked to establish a printed equation such as " $x^2 - x - 2 = 0$ ", it is important to include " $= 0$ " .
- The value of $\sqrt{36}$ is 6 and not ± 6.
- Candidates should know the expansion $(x + y)^2 = x^2 + 2xy + y^2$, and they should be able to multiply out brackets without always having to rely on a grid method.
- When completing the square for $ax^2 + bx + c$, candidates need to practise cases when $a \neq 1$ and when $\dfrac{b}{a}$ is not an even integer.
- When using the Factor Theorem, it is not sufficient to show that $p(-2) = 0$: a statement such as "therefore $x + 2$ is a factor" should appear.
- Those who always use $y = mx + c$ for the equation of a straight line must take greater care when evaluating c .
- When solving a quadratic inequality, it is wise to use a sketch or a sign diagram.
- It is essential to use correct algebra, including relevant brackets, in completion of proofs.
- Wrong quadratic factors should never appear – they can be checked by multiplication.

Question 1

In part (a), there were some very good sketches, although not all indicated the values of the intercepts as requested. The most common omission was the *x*-intercept of the line, $(\frac{1}{3}, 0)$, possibly because it involved a fraction. The other common error was the omission of the *y*-intercept of the curve. Many wrongly assumed $(0, -3)$ to be the minimum point of the curve. A few drew the parabola upside down but were given some credit if they marked the correct intercepts on the *x*-axis. Many who plotted points produced a J-shape that failed to cross the *x*-axis twice.

In part (b), there were many satisfactory solutions, although quite a few candidates presented their proof in part (a) or (c) of the question. Some omitted "$= 0$" even though the equation was printed in the question paper. A few candidates guessed two values, possibly from their graph, and merely checked them in the given equation and scored no marks. Many weaker candidates made no attempt at this part.

Part (c) was answered well, although a few stopped after finding only the *x*-coordinates. Some wrongly substituted these values into $x^2 - x - 2$, instead of the equation of the line or curve, and thus failed to find the *y*-coordinates of the points of intersection. Quite a few picked out at least one of the pairs of coordinates, possibly using their graphs, and this was given credit.

Question 2

Far too many candidates believe that $\sqrt{4} = \pm 2$. Clearly some candidates had not covered this topic. However, a good proportion of the entry scored full marks.

In part (a), many left their answer as $\sqrt{36}$ or $3\sqrt{4}$, while there were many incorrect answers such as $4\sqrt{3}$.

In part (b), many earned the method mark for, say, multiplying by $\frac{\sqrt{3}}{\sqrt{3}}$ or converting $\sqrt{12}$ to $2\sqrt{3}$. However, not all could correctly complete their solution. The most common error was writing $\frac{2\sqrt{3}}{\sqrt{3}} = \sqrt{3}$.

There were two approaches for part (c). Some substituted for x and y and then attempted to multiply out the two brackets. Most simplified $(\sqrt{3})^2$ and $(\sqrt{12})^2$ successfully, but the simplification of $2\sqrt{3}\sqrt{12}$ caused problems. The other popular approach was to add $\sqrt{3}$ and $2\sqrt{3}$ and then square $3\sqrt{3}$. Unfortunately the brackets were often omitted and a final answer of 9 was presented.

Question 3

Some candidates did not attempt part (a). However, those who could square $9 - 3x$ usually earned the marks. A surprising number substituted for both x and y and most were unable to complete the solution successfully.

In part (b)(i), the differentiation was carried out very well by most candidates. Errors in the value of k occurred due to taking out a common factor either before or after differentiating, so values of k such as 3 and 9 were common. A few weak candidates did not recognise that they had to differentiate V here, and generally were unable to proceed through the rest of the question.

In part (b)(ii), the factorisation was usually carried out successfully, and candidates who had not found the correct value of k were still able to earn these marks.

The most common error in part (c) was differentiating $x^2 - 4x + 3$, rather than $27(x^2 - 4x + 3)$, and this approach earned a method mark only.

Credit was given in part (d)(i) for substituting their values of x into their second derivative and so most candidates earned this mark, provided they had two values of x.

In part (d)(ii), most realised that $x = 1$ needed to be selected since $\frac{d^2y}{dx^2}$ was negative when $x = 1$.

In part (d)(iii), not all substituted $x = 1$ into the equation for V. Those who did often made arithmetic errors. Some gave the value of y when $x = 1$ and others gave the answer as -54, the value of $\frac{d^2y}{dx^2}$ when $x = 1$.

Question 4

This question was not answered very well in general. The fractional values of p and q caused problems.

In part (a), although many found the value of p correctly, far fewer obtained the correct value of q. Once more arithmetic errors occurred, particularly when calculating $4 - \frac{9}{4}$.

Very few candidates understood what was required for part (b). Many hedged their bets and wrote their answer in coordinate form, $(1.5, 1.75)$, whilst many others thought the minimum value was 1.5.

In part (c), many earned a mark for the word "translation", provided it was not combined with another transformation. However, the wrong vector was very common; few recognised the link with part (a) and used 3 and 4 instead of their values of p and q.

Question 5

Part (a) was usually answered well and several correct equations were seen. However errors such as $\frac{-15}{-3} = -5$ sometimes occurred, and weaker candidates confused coordinates and wrote equations such as $y - 15 = m(x + 2)$. Some attempted to differentiate to find the gradient instead of using the coordinates of the points.

Although the integration in part (b)(i) was largely successful, the evaluation of $F(1) - F(-2)$ defeated most. Arithmetic errors, usually caused by minus signs and fractions, abounded.

Some assumed that they had answered part (b)(ii) by substituting the limits after integration. Of those who realised the need to subtract the area of a triangle, many assumed the triangle base to be 4 rather than 3. Another error seen was the integration of the curve from –2 to +2 followed by subtracting their answer to part (b)(i). Some successfully found the area under the line by integration, but that was not the expected method.

Question 6

Most used the Remainder Theorem very successfully in part (a). A few found $p(1)$ to be -18, but then stated that the remainder was $+18$ and lost a mark. Some used long division and, because they had not used the method stipulated, they were not awarded any marks.

Many candidates lost a mark in part (b)(i) for failing to make a statement regarding the factor: they assumed that it was sufficient just to show that $p(-2) = 0$.

In part (b)(ii), those who found the quadratic factor $x^2 - x - 6$ by long division usually went on to earn full marks. Some used the Factor Theorem but the repeated factor was problematic. Those who used inspection or comparing coefficients generally scored at least one mark. Not all candidates wrote the final answer as the product of three linear factors and were possibly confused by the repeated factor.

In part (c)(i), almost all candidates stated the value of k as -12, but a few wrote $+12$.

Most candidates found the graph in part (c)(ii) to be a difficult one to draw. Parabolas through (–2,0) and (3,0) were common and scored no marks. Those who drew a cubic shape usually had three intercepts on the *x*-axis and this was awarded one mark. Once again, the repeated root confused many. Some of those who made a good attempt lost a mark for having the minimum point on the *y*-axis.

Question 7

In part (a), while many found the centre and hence the values of a and b correctly, far fewer were able to find the radius. A very common incorrect answer was $\sqrt{233}$ instead of 13. A few candidates substituted the coordinates of the centre into the given equation so wrote $(8-a)^2+(13-b)^2=$ ... and earned no marks. Too many candidates were drawn into fruitless calculations when all they needed to do was refer to the diagram.

In part (b)(i), the gradient of PC was usually correct.

The most common error in part (b)(ii) was a misunderstanding of what was required. Many assumed that the tangent was the straight line passing through P and C and used their answer to part (b), instead of its negative reciprocal, as the gradient. Not all of those who found the correct equation converted it to a form with integer coefficients.

In part (b)(iii), a surprising number of candidates did not realise that the distance from C to P was the radius, and recalculated it. It was a pity that they did not return to part (a) and correct their circle equation.

Those who drew a sketch usually used Pythagoras's Theorem correctly, but many failed to recognise that the distance required was the length of the perpendicular from the centre of the circle to the midpoint of the chord. A few obtained the correct answer by considering a horizontal chord and finding the point of intersection with the circle.

Question 8

The most common error by far in part (a) was the omission of brackets in $(4k)^2$. Usually $16k^2$ appeared after $4k^2$ had been seen in the line above. Candidates must be far more careful when proving a given answer in order to convince the examiner. It is essential to address the inequality by stating the condition for real roots early in the proof, rather than just inserting it into the final line.

In part (b), factorisation of the quadratic proved too difficult for many, with the most common error being wrong signs in the brackets or the roots. Some used the quadratic formula, but the calculation of $(-9)^2 - 4 \times 4(-9)$ defeated many.

Of those who calculated the critical values correctly, many assumed that they had answered the question and stopped. It was good to see more candidates showing their method of solution of the inequality by drawing a sketch or sign diagram. It was a pity that many of those who obtained the correct answer then wrote their final answer as $3 \leqslant k \leqslant -\frac{3}{4}$.

Mark Ranges and Award of Grades

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