Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

January 2022

Pearson Edexcel International A Level
In Pure Mathematics (WMA11/01)

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General

This paper proved to be a good test of candidates' ability on the WMA11 content, and it was pleasing to see many candidates demonstrating what they had learned despite the anticipated disruption to learning experienced. Overall, marks were available to candidates of all abilities and the parts of questions that proved to be the most challenging were 4(d), 9 and 10.

There were a number of parts which stated that either relying on or entirely relying on the use of calculator technology was not allowed so attention should be paid to this information at the top of relevant questions. These were 3, 4 and 8(c)

There were a number of blank responses to questions towards the end of the paper and on some of the different questions for different candidates. This suggested that candidates may have struggled for time due to the not being as familiar with the content as they would have typically expected to have been and this may have had an impact towards the end of the paper.

Report on individual questions

Question 1

This integration question provided a simple start to the paper and was answered correctly by the vast majority of candidates who understood integration and could follow the rules of raising the power by one and dividing by the new power.

When integrating the expression, the first term was typically integrated correctly with the power increased by one and the coefficient correctly divided by 4 to yield a correct term. When integrating the second term the negative power was usually dealt with correctly, although some candidates found it harder to process the coefficient accurately and in some cases were not able to yield terms with the correct sign.

The majority of the candidates integrated the constant term to achieve the required form of $-x$ or $-1x$. A relatively small number of candidates failed to include $+c$ to their final answer.
A very few number of candidates attempted to differentiate the given expression thus scoring no marks and others lost the final A mark by adding the integral sign in the front of their correctly integrated expression.

Question 2

This was a relatively straightforward question. Most candidates found this question accessible though candidates were not always able to follow the links between parts (a), (b) and (c).

In part (a), many candidates factorised to obtain -2 for B1 and whilst a majority of candidates attempted to complete the square with many correct solutions to this part of the question, some struggled with signs and bracketing they were still able to score a two of the available marks. There were also slips made in finding the constant. Whilst any achieved the correct constant of 13, values of 12, 11 or 15 were the most common incorrect values.

In part (b), most candidates produced graphs of the correct shape, although some were poorly drawn. There were some positive quadratic shaped graphs and a few cubics seen. A very few number of candidates drew curves that did not reach the x-axis. The only value required was where the curve crossed the y axis (0,11), but many candidates spent time finding the co-ordinates of the turning point and the values of x where the curve crossed the x-axis which were not required. Many candidates did not link completing the square in (a) with sketching the graph whilst a number of candidates had (0,11) as the maximum point of their curve so scored only M1 for this part; others had the maximum in the first quadrant, also just scoring M1.

In part (c), this was often missed out or even forgotten about. Candidates were often not linking part (a) to part (c). Where an answer was given, $x = -1$ was correctly found in most cases. $x = 0$ was a common error following the maximum being on the y-axis. $x = 1$ following from factorising as $(x-1)^2$ in (a) scored A1ft. $y = 13$ was another error seen several times.

Question 3

This was one of the better attempted questions on the paper, which was testing standard procedures, even though it precluded the reliance on calculator technology. Only about a quarter gained full marks but very few failed to score any marks while about half scored at least five out of seven.

Part (i) was usually completed successfully, with most showing the required expansion and simplification of the surds to the required form. The most common error tended to be sign slips. The entire question asked candidates not to use calculators, so it would be advisable for candidates to be reminded of the need to show all of their stages of working which includes how to convert $\sqrt{8}$ to $2\sqrt{2}$. Whilst strict sight of this was not required on this particular paper, this does not mean that this would not be penalised in the future on questions of a similar demand.

In part (ii), most were able to expand the brackets correctly and isolate the y terms on one side. The majority then made y the subject. Unfortunately, at this stage some failed to show the rationalising of the denominator or the expansion of the numerator in order to demonstrate non-reliance on technology. These candidates lost the final two marks. A small minority attempted to square both sides but very few of these were able to show their methods, by completing the square, to achieve the form of the answer without relying on calculators.

Question 4

This question had two parts to it. Part (a) required candidates to equate a quadratic and straight-line equation to find the coordinates of 2 points of intersection. Part (b) required pupils to identify the shaded region R using inequalities.

As with previous examination papers this question stated, "In this question you must show all stages of your working. Solutions relying on calculator technology are not acceptable" A significant number of candidates did not appear to follow the guidance and subsequently only gained 1 mark out of 4 in part (a).

In part (a), the most successful method seen was to form a quadratic equation in x. Most candidates were able to solve this equation to find the correct coordinates for P and Q. Those showing a method for the above generally favoured factorising or the quadratic formula over completing the square. Unfortunately, some did not show sufficient working, or used their calculator to state their x or y and hence no more marks could be awarded in part (a).

Some candidates chose to form a quadratic equation in y instead, but generally this method led to an incorrect 3TQ.

Part (b) required identifying a shaded region bounded between the quadratic, line and x-axis using inequalities. Many candidates gained the M mark for two inequalities, using the line and quadratic. Those that scored 2 marks generally had the line, curve and $x > 2.5$. Very few candidates scored all marks in this question, the most common error being to omit $y > 0$. Occasionally a candidate would use "R" instead of y in the inequalities which was not accepted. Some others did not reference y at all, making the "line < curve" into an inequality in x. Some candidates unnecessarily solved $2x^2 - 6x - 1 = 0$ before stating the incorrect condition $x > \frac{3+\sqrt{11}}{2}$.

Question 5

This question was very accessible in part (a) and part (b), while correct answers to part (c) were less common. A large proportion achieved full marks but nearly a quarter scored 1 or 0 overall.

In part (a), the majority of the candidates were able to show the correct method for the angle given. Some converted to degrees, but were typically successful in showing the conversion back to radians to achieve the given answer.

For part (b), most used a correct formula for the area of sector and continued to obtain the area of the segment. A few candidates tried to convert 1.742 radians to degrees and use an equation for degrees, and they usually did succeed in reaching a correct solution. Common errors included approximating values too soon or using the wrong angle. A few found the area of the triangle and then stopped. Some split the triangle into right-angled triangles and successfully achieved the area required.

In part (c), the vast majority of candidates applied the correct method to find the arc length, though there were some who stopped at this stage. Many did go on to use it to obtain the perimeter. Candidates sometimes struggled to find the length of the chord *BD* mistakenly using *BOD* as a right-angled triangle.

<u>Question 6</u>

This question was successfully answered by a pleasing number of candidates who were able to handle the combination of the coordinate geometry and integration topics.

Part (a)(i) was usually very well attempted with $x = 4$ substituted into the given gradient function $\mathrm{f}'(x)$ leading to $\frac{49}{8}$ or 6.125.

Some candidates multiplied out $(x+3)^2$ for $\mathrm{f}'(x)$ and then attempted to divide by $x\sqrt{x}$ before substituting $x = 4$; this approach sometimes led to the wrong value for the gradient due to algebraic errors.
Some candidates did not understand the $\mathrm{f}'(x)$ notation and were unable to score the mark here.

In (a)(ii), most candidates successfully used $y - y_1 = m(x - x_1)$ or $y = mx + c$ to find the equation of the tangent with *m* being their gradient from part (i) and $x_1 = 4$ and $y_1 = 20$. Common errors for this part were leaving the equation in a non-integer form and making slips in rearranging their equation.

Part (b) was successfully completed by many candidates. The most common error was incorrectly dividing the given gradient function. Dividing by $x^{\frac{1}{2}}$ instead of $x^{\frac{3}{2}}$ was the usual incorrect method seen. More successful candidates could integrate but omitted a constant of integration or they had a constant of integration but failed to use $x = 4$ and $y = 20$ to find the value of their constant. Occasionally candidates made a numerical slip when simplifying their integrated terms. The first two A marks were for three correctly integrated terms. As this mark could be scored at the unsimplified stage, it is good practice with questions of this type to show unsimplified stages of working.

Question 7

This question proved accessible to most candidates with around a quarter achieving full marks. The first two parts of this question tested knowledge of function notation and transformation, with the last two parts being more standard, testing expansion of three brackets and use of the gradient function. Almost all candidates gained some marks, and it was common to see fully correct solutions.

The majority of candidates found $p = 22$ correctly in part (a), often without showing working. Common mistakes were $p = -22$, which generally gained no marks, and slips in multiplying the factors after substituting $x = 0$. A significant number expanded f(x) in this part, which gained them credit in part (c).

Part (b) was less well attempted, with no attempt made on a number of scripts. Frequent errors were to give just one value of q or, quite frequently, just the positive values, thus forfeiting the second mark. A number of candidates wrote $x = -4, 2, 4.5$ but then changed the signs for q and so lost both marks. Candidates who expanded f(x) in (a) were less likely to succeed here as they often attempted to use their expanded form.

Overall part (c) was well answered. Almost all candidates gained the first mark for a correct expansion attempt (often gained in part (a)). A minority made slips in collecting terms or sign errors and so lost both A marks. Almost all differentiated their expression correctly, with only a very few attempting to integrate the function.

A minority of candidates gained no marks in part (d) as they were either unable to link $\mathrm{f}'(x)$ found in (c) with the gradient, sometimes attempting f(x) = 0, or they solved $\mathrm{f}'(x) = 0$. Of those who used a correct method, most proceeded to find the critical values, with most errors being sign slips in the rearrangement or writing 18 in place of -18. Some stopped at the critical values, but if an inequality was written, the inside region was almost always chosen.

Question 8

Candidates were usually able to make a reasonable amount of progress in this question with parts (a), (b) and (c) scoring a pleasing number of marks. Part (d) was a good discriminator between the candidates.

On the whole, part (a) was well done with most candidates writing that the gradient was $\frac{2}{5}$

It was disappointing to see a significant number correctly rearranging the given form of the equation but not extracting the required gradient and those who just picked out the "2" from the given "2x" and stated that this was the gradient.

Part (b) was answered quite well done with most candidates getting full marks. As was to be expected from previous papers, common errors included using the gradients $\frac{2}{5}, -\frac{2}{5}, \frac{5}{2}$. A common mistake was not to give their final answer in the required format.

Part (c) was, on the whole, answered well. Candidates generally knew that they were solving a simultaneous equation and the most successful method was to set the two lines equal to each other. Methods involving substitution of their line in part (b) into the given line were the next most common but less successful attempts. The main stumbling block for weaker candidates was dealing with the algebra which involved several fraction terms. It was also disappointing to see candidates miscopying their own handwriting.

In part (d), there were a variety of responses, although many candidates left this part blank. Some candidates simply wrote down the correct answer without any explanation. Amongst candidates who made an attempt there were three types of approach:

- A method involving midpoints proved to be reasonably successful most of the time, but as ever, a few candidates did not know the correct midpoint formula. Some found the midpoint of A and M.
- A method involving vectors was probably the most successful.
- Methods involving distance formulae were always unsuccessful.

Candidates who drew diagrams often drew an upright square rather than one that gave appreciation to the whole situation.

Question 9

This question proved more of a challenge than expected for many candidates.

Many candidates were confused by the fact that it was not just an enlargement with scale factor 3, or a stretch scale factor 3 parallel to the vertical direction, but also a reflection in the horizontal axis. So, many of them gave $A = 3$ rather than $A = -3$
In part (b), the majority of those who attempted the question successfully found the y coordinate was 3.
Perhaps due to the few marks available, candidates did not expect to do much work for the x coordinate and so very little working was seen. Candidates did not show any calculations and very few seemed to be attempting to write a scale on the horizontal axis. The majority made no attempt and those who gave a value for the x coordinate ranged from 330 to 1110.

Answers of 960 and 900 were possibly as a result of considering the period being 360° and making a slip with the – 30 from P. It was not easy to even work out how some of the answers had been obtained. Consequently, the final 2 marks tended to be either 0 or 2 as solutions were not seen where an incorrect value was given from a correct statement. Very few candidates showed evidence method and if there was evidence present it tended to be candidates attempting to label maximums and minimums on the given graph.

Question 10

A significant number of candidates did not even attempt to answer this question. For those candidates who did attempt it there was a wide variation of outcomes. Generally, the quality of many sketches was very poor. On the whole this question felt rushed, and unfinished in many cases; perhaps to be expected as the last question on the paper. This possibly contributed to the number of simple slips in what was a relatively straightforward question.

In part (a), a good number of candidates were able to draw the correctly shaped graph for $y=\frac{1}{x^2}$, but there was also a large proportion who drew the graph of $y=\frac{1}{x}$ or even $y=x^2$. This would suggest that candidates either did not have access to a graphical calculator or were simply unable to use one. The x-axis intercepts were generally correct, where present. Some did not simplify and left their answers in terms of $\sqrt{9}$, which did not score the mark. Most knew to translate their graph down by 9 units and identified an asymptote at $y=-9$, occasionally mis-labelled as "-9" or "$y=9$". The asymptote of $x=0$ was frequently missed although the sketch did have the correct asymptote. Those who drew a reciprocal graph would have been able to score 2 of the 4 marks available for both asymptotes correctly shown and labelled.

Part (b) required candidates to form a 3TQ in x^2 and some struggled to do this correctly, demonstrating a weakness in algebraic manipulation. Most candidates however achieved the quartic (some sign errors were seen) and were able to express it as a quadratic in x^2. Those candidates who were unable to complete this step generally failed to make further progress. Once a quadratic had been identified, candidates were generally successful in using the discriminant to produce an expression in terms of k, and subsequently identified $...\frac{81}{4}$ as the critical value. Some obtained this value from an incorrect quartic, and these lost both A marks. Occasionally a sign error was made resulting in a critical value of $\frac{81}{4}$.

Very few candidates identified the condition that $k<0$ was also required to produce the 4 intersections required. The use of the graph to help identify whether a quadratic should be positive or negative was rarely seen.

Very few candidates found the full solution $-\frac{81}{4} < k < 0$, although most stated $k > -\frac{81}{4}$. A common mark profile for this part of the question was 01110.

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