Examiners' Report
Principal Examiner Feedback

October 2022

Pearson Edexcel International Advanced Level
In Pure Mathematics P1 (WMA11) Paper 01

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October 2022
Publications Code WMA11_01_ER_2210

General

This paper proved to be a very accessible paper for candidates on the WMA11 content, and it was pleasing to see many candidates scoring well on most of the questions. Overall, marks were available to candidates of all abilities and the parts which proved to be most challenging were 4a, 6b and 9c, whilst question 7 proved to be the most challenging overall.

Report on individual questions

Question 1

This was a nice accessible question and provided a positive start to the paper. Most candidates were able to score some marks, and a good proportion of candidates achieved full marks.

In part (a), candidates needed to reduce the power on any one of the terms to score the first mark and so candidates who performed integration rather than differentiation generally scored zero marks. Candidates who attempted differentiation usually only made an error in differentiating one of the three terms; there were a variety of common errors, including $\frac{17}{x}$ becoming $-17x$, and $\frac{x^3}{4}$ being differentiated to $12x^2$.

Part (b) was generally well attempted by the majority of candidates, and many scored full marks. There were a variety of relatively common errors which resulted in the loss of one mark. These included not writing the equation in the required form, an incorrect sign on one of the final terms in the equation, a numerical error leading to an incorrect value for the gradient and writing the final answer as an expression rather than an equation. Responses which resulted in a loss of more than one mark tended to occur when candidates used the original equation to find the gradient rather than the gradient function, or when they found the equation of the normal rather than the tangent.

Question 2

This was a very successful question for most candidates with just over half scoring full marks.

In part (a), most candidates were able to correctly expand the expression to obtain a cubic expression with correct coefficients. Occasionally candidates did miscopy their coefficients when stating the values of a and b, but this was condoned.

In part (b), most candidates were able to use the expanded expression to write the fractional expression as the sum of terms, with a good degree of success. Where candidates used the correct index form for the denominator of the fraction, they were typically able to simplify each term correctly obtaining the correct coefficient and power of x. Some candidates processed the powers correctly but multiplied the coefficient of each term rather than dividing. Other common errors included adding on the term from the denominator or trying to simplify the expression using the factorised form. Typically, candidates were able to increase the power of a non-integer power by 1 to attempt the integral of the expression. This was generally completed accurately, although some candidates found it difficult to process the integral correctly when dealing with a fractional power. There were some sign errors in simplifying terms, and some candidates failed to include the $+c$ when completing the integral.

Question 3

This modelling question relied on setting up simultaneous equations and solving. This was the most successfully answer question on the paper with over three quarters of all candidates being able to score full marks.

In part (a), only a few candidates did not know how to set up the simultaneous equations. Many candidates had correct equations and solved them correctly but slips in solution cost both accuracy marks. Occasionally some candidates got their p and q mixed up or did not know how to proceed to the answer. It was acceptable for candidates to use their calculator to solve the simultaneous equations on this occasion.

In part (b), most candidates were able to achieve the correct answer, although the most common error was to fail to give the answer to 1 decimal place, as required.

Question 4

A disappointing number of candidates failed to score full marks on this question with too many failing to show detailed reasoning.

In part (a), candidates are generally realising the requirement to show more working with the emboldened reminder at the top of the question. Questions like this have been asked in the past and many now show their factorised quadratic before proceeding to the roots of the equation. There were still some, however, who appear to work backwards, making use of calculator technology, but then their factorised form does not match their quadratic. It is important that candidates check their solutions are complete. Others opted to complete the square or use the quadratic formula, which demonstrated their understanding as to how to solve a quadratic equation.

Part (b), again, required candidates to show their working and, in particular, they need to show how they would deal with the fractional power. Solutions relying entirely on calculators failed to score here. A substantial number of candidates jumped straight to the answer without showing the steps required. The second most common error was to leave $y = 0$ and / or $y = -\frac{5\sqrt{10}}{4}$ as solutions even though the question stated that $y > 0$.

Question 5

This question was answer well by most candidates, with just under half scoring full marks.

In part (a), the majority of candidates realised that they needed to integrate in order to obtain an expression for f(x), and most were able to integrate each of the three terms correctly. Errors typically came from incorrectly simplifying the coefficient of the term, with division by $\frac{1}{2}$ being the main cause of errors. Where candidates included the $+c$ they were then able to proceed to finding a value for c using the values of $x = 8$ and $y = 9$, usually successfully calculating the correct value. A small number of candidates did not include the constant of integration for a correct integral in part (a) and were therefore unable to progress beyond the first three marks for the question.

On the whole, in part (b), candidates were able to accurately evaluate $f'(9)$ to achieve the gradient of the tangent and use the negative reciprocal to find the gradient of the normal. Candidates were typically able to proceed to an equation of the normal using a changed gradient, and then substitute for $x = 0$ to find the intersection with the y-axis. Some candidates incorrectly substituted for $y = 0$, or attempted to find the equation of the tangent rather than the normal. Others just stated that $c = 11$ which did not fully demonstrate that they had understood what the question had asked.

Question 6

This question required candidates to sketch two different curves from a given equation and proved to be a challenge for many candidates. Solutions scoring full marks were relatively infrequent and some candidates made no attempt to answer this question.

Part (a)(i) required candidates to sketch a positive cubic curve with a repeated root. Most candidates recognised that the equation represented a cubic with two turning points, but there were many other key features that they were unable to identify from the equation. Common errors in the sketches included, sketching a negative cubic, sketching a curve which passed through the origin and sketching a curve which passed through the x-axis at $(-4,0)$ rather than turning. Some candidates were unsure how to deal with the unknown value for k, and sketched either a single curve or a family of curves for specific values of k. Despite the instructions given in the question, a lack of labelling on the coordinate axes was another common cause of lost marks.

Candidates generally recognised that the equation given in part (a)(ii) represented an asymptotic curve and many scored one mark for having a correctly shaped curve in one of the correct quadrants. There were a variety of errors which prevented candidates from scoring both marks in this part of the question, the most common being, sketches showing a horizontal asymptote at $y = k$, only sketching one section of the curve, sketching the curve in the first and third quadrants rather than the first and second, and less commonly sketching a curve in all four quadrants.

The intent for part (b) of this question was for candidates to use their sketches from part (a) to determine the number of roots of the resulting equation when the two functions were set equal to each other. To score the mark in part (b), the sketches were required to be the correct shape and in the correct position. Many candidates had not met this requirement and were unable to access this mark. On occasion, candidates who had not sketched the curves made an unsuccessful attempt to find the number of roots using an algebraic approach. Where sufficient sketches had been drawn, candidates needed to explain that the equation would have one root as there was one point of intersection between the two curves. Many candidates proceeded to do this successfully, and it was pleasing to see that very few had just written down "one root" without attempting to explain their reasoning. Some candidates misinterpreted the question and answered that there were two roots as the cubic curve had two x-intercepts. Candidates should make sure on questions like this that they give sufficient detail and make it clear that it is the intersection of the curves rather than the ambiguity of intersections which could be in relation to the coordinate axes.

Question 7

This question proved to be one of the more challenging on the paper with only a fifth of all candidates scoring full marks.

In part (a), most candidates were able to identify the critical values that corresponded to the required inequalities, but then were unable to use the correct inequality signs to show the required ranges. The majority of candidates expressed their answers using inequalities, but there were some correct attempts using alternate notation. Some candidates struggled to find the "inside" region, despite having the correct endpoints.

Part (b) was correctly answered by most candidates, although some offered a number of possible solutions without identifying the greatest value.

When transforming the graph in part (c)(i), most candidates correctly reflected in the y-axis, and stated the correct transformations of the points P, Q, R and S. Some candidates failed to achieve the higher turning point in quadrant one, despite having reflected the original graph and correctly mapping the points P, Q, R and S. There were instances where candidates incorrectly reflected in the x-axis or applied other transformations of the curve.

Whilst many candidates attempted part (c)(ii), often candidates provided other inequalities in addition to the correct answer and were therefore unable to score a mark on this part of the question.

Question 8

This was one of the two longer questions at the end of the paper and there was a good spread of marks differentiating the candidates. Typically, candidates scored just over half of the available marks on this question.

In part (a), the majority of candidates were able to correctly identify angle AOB for the first B1 mark. Those who found the angle were able to achieve both marks for finding the correct area of the sector leaving it in exact form. However, too many failed to show the area as an exact value, as required, thus forfeiting the accuracy mark. Most candidates used the appropriate formula for the arc length, but many forgot to add the two radii to find the perimeter of the sector. The accuracy mark was also lost by those who gave the answer as a rounded decimal and never showed the exact value required.

In part (b), it was pleasing to see the majority of candidates were able to achieve both marks for finding the area of triangle AOB exactly. It was only the candidates who did not simplify their answer before giving a decimal answer who tended to not score full marks, with the occasional candidate using an incorrect formula.

Part (c) of this question saw most candidates only score one out of the two marks available, especially if they chose the cosine rule option. This is because they did not include sufficient steps to 'show that' for the accuracy mark, although most were able to correctly use the cosine rule. There were a small number of candidates who used the other options that were covered in the mark scheme. Once again, there was often insufficient working for a ‘show that’ answer. Candidates should be reminded that where an answer is given, it is the steps leading to the answer where the marks will be awarded.

Part (d) proved to be a great opportunity for a pleasing number of candidates to achieve full marks. Most candidates scored at least two marks for correctly processing the sine rule for angle BAC. However, the second method mark was lost when candidates failed to identify the correct angle. Some candidates used the wrong angle when attempting to find the area of triangle ABC, either using their value for sin BAC instead or subtracting from 2π instead of π. A minority of candidates attempted to find the length AC using the cosine rule instead of the angle BAC. The third method mark could only be given following correct attempts at angles BAC and ABC.

Question 9

This was another long question at the end of the paper and there were some signs of fatigue by some of the weaker candidates who had very mixed success with this question. Some responses were left completely blank.

Part (a) was well attempted by many candidates with the majority correctly identifying $\frac{1}{2}$ as a factor, and many dealt with the first two terms correctly, scoring the first two marks. Where errors were seen it was usually in the second term where *b* was found to be either $\frac{5}{2}$ or less commonly 20. Numerical errors in the constant term were more common with $c = 22$ and $c = -78$ (from $-10 + 22$) being common incorrect answers. In the majority of correct solutions '$-100 + 44$' or equivalent was seen. Some responses with correct answers had no working and, whilst not condoned on this occasion, candidates should be reminded that they should always show their working, even when there is not the emboldened warning at the top of a question.

Part (b) was the part of the question where candidates had the most success. The most efficient method was to use the completed square form from part (a). Candidates who did this correctly scored full marks whether their answer to part (a) was correct or not. It was very common for candidates to start the question again using the strategy of solving $\frac{dy}{dx} = 0$ to find the correct point. Candidates who used either strategy were generally successful.

It was usual for candidates to score either full marks or zero marks in part (c)(i). Candidates who used the given equation of the normal to find the gradient of the tangent usually deduced a fully correct strategy, differentiating and setting the derivative equal to the equation of the tangent and solving to find *x*, and subsequently *y*. However, although it was clearly stated that the line *l* was the normal to the curve, many candidates treated the gradient of *l* as the gradient of the tangent. In this case it was very common for candidates to equate the equation of line *l* with the equation of *C* and use the determinant of the resulting quadratic to find a value for *k*. This approach was incorrect and scored zero marks. It was possible to use a similar approach equating *C* with the equation of the tangent, however candidates who attempted this usually made an error or gave up before they had reached the correct answer. Candidates who had completed part (c)(i) correctly invariably went on to score both marks in part (c)(ii).

Part (d) of this question offered a good example of a situation whereby having the resilience to persevere with a question you are finding challenging, it can pay dividends. Whilst many candidates made no attempt at part *d*, other candidates who had struggled with part *c* went on to score the first two marks. A mark was awarded for each correct inequality and both strict and non-strict inequalities were accepted, although these needed to be used consistently to score the final mark. Inequalities needed to be expressed in terms of *y* and *x*, and those which were given in terms of *R* scored zero marks; there were less of these types of responses than in previous exam sessions. Candidates who attempted this part of the question usually scored at least one of the three available marks. The other most common reasons why marks were lost were for the inequality signs being the wrong way around (particularly for the inequalities for *y*), expressing an inequality in terms of *k*, or using an incorrect value for *k* for the final mark.

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