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Examiner's Report
Principal Examiner Feedback

October 2019

Pearson Edexcel International A Level
In Pure Mathematics P1 (WMA11/01)

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October 2019
Publications Code: WMA11_01_1910_ER

General

This paper proved a little more challenging than the summer paper, with questions 8 and 9 in particular causing difficulty. Being the third WMA11 under the new specification, the newer topics were approached with greater confidence, but there were places where many sutdents were unable to work out a suitable method that led to a number of marks being lost. The final question was well attempted by the majoirty, indicating the problems on the paper we not due to timing.
Of note throughout the paper is the fact that many students still work in and give decimal answers where exact answers are asked for – sometime the decimals followed a correct exact answer but often not. However, there was generally a sufficiency of working shown in questions where it was asked for, student picking up on the instructions of the question more than in previous series.

Question 1

An accessible opening question, answered fully correctly by over two thirds of the cohort. A failure to give an exact answer, particular in (b), was the main failing for those who did not achieve full marks. In part (a) the majority of the students used a correct formula for the area of sector and continued to obtain the exact vale of r. A common mistake was to give $r = 4.899$ instead of or $2\sqrt{6}$, but errors in calculation were rare. A few students tried to convert 1.25 radians to degrees and use an equation for degrees, but they usually did not succeed in reaching a correct solution.
In part (b), the vast majoirty of students applied the correct method to find the arc length, though there were some who stopped at this stage. Most did go on to use to obtain the perimeter. Students often gave both the exact and decimal value of r in part (a) which caused them to find the perimeter as 15.9 cm and therefore lost the accuracy mark.

Question 2

Question 2 saw a traditional linear simultaneous equations problem set in the context of a growing tree, the height of which is modelled by a linear equation in t. The most common approach was to form two linear equations in a and b using the information provided, then to solve for the unknowns. This was completed accurately by over 80% of students with the correct values for a and b found. The alternative approach to form an arithmetic sequence or use the difference over 5 years was less common, but still done well when attempted. However, mistakes were more common via this approach.
Part (b) caused the difficult in this question with only half of students who successfuly completed part (a) going on to achieve the mark in part (b).This highlights a need for students to be familiar with questions posed in context and the need to understand their numerical solutions in the context of the problem. Although many correctly stated their value for 'b' as being the height of the tree when it was planted, a lack of units often prevented the mark from being awarded. Another common mistake in part (b) was to misinterpret the time 'when the tree was planted' as corresponding to t=1, leading to the incorrect answer of 1.53m.

Question 3

This question proved to be a good discriminator between high and low grade bands, with good students able to access all except the final mark, while others could make little progress beyond part (a), in some cases making no attempt at all. The final mark was particularly dsicriminating with only the top 3% of students achieving full marks on the question, while 25 % were unable to score more than 3 marks.
For part (a) students most often attempted completion of the the square in order to find the coordinates of the minimum point of the curve, though the alternative methods of setting their derivative to zero or applying $-b/2a$ were also successfully employed. Those completing the square were by and large the ones who had greatest success throughout the rest of the question. In contrast there were a significant number of students who tried to solve the equation $x^2 - 5x + 13 = 0$ in an

effort to find the coordinates of the minimum point, and these generally did not make further progress in the question thereafter.
It was part (b) that proved a discriminator, with many students not knowing how to get started. Many failed to use that the line passed through the origin and this generally led to no marks being scored. But most did attempt the correct line, identifying 2.7 as the gradient, though not all demonstrated the knowledge that a line that goes through the origin must be of the form $y = kx$ as there were a number of attempts at $y - 27/4 = 2.7(x - 5/2)$, and these were sometimes simplified incorrectly. However, the method of attempting to solve the two equations simultaneously was shown by most. Those who were able to write the equation of the line l as $y = 2.7x$ usually reached correct values for the exact coordinates of the point N.
In part (c) only the most able candidates could write all of the three inequalities that descibed the region R. The most common score was one mark in this part, with the method mark usually awarded for obtaining both required inequalities in y. The inequality $0 \leq x < 2.5$ was rarely given correclty, with the upper limit almost always missing. There were also quite a few students lost marks for using $\boldsymbol{R}$ instead of y.
It is noteworthy with regards to notation that many students mixed up loose and strict inequalities, though this may be due to misunderstanding the role of the dotted verus solid borders.
A few students used integration in an attempt to find the area of the shaded region instead of writing inequalities to describe it.

Question 4

This question proved more of a challenge than expected for many students. About a third scored no marks at all, and only just over a third scored full marks. In between, 2 marks was the next most common score, obtained by those who only found the acute angle, but did attempt the cosine rule with it. There were many blank responses.
For this question a diagram summarising the given information would have been helpful for students, but was often missing, while others drew a parallelogram showing an acute angle *BAD* having not paid careful enough attention to the question. As a result, incorrect attempts followed, such as use of Pythagoras' theorem to find the length of the diagonal *BD* before attempting the cosine rule with their diagonal.Those who identified the angle correctly in a diagram would usually go on to score full marks.
There were a lot variations in the attempts. As well as the main method of the mark scheme, finding the height of the paralleogram and then proceeding with an appropriate trigonometric relationship or pythagoras theorem was a common approach. It is also noteworthy that students seem to prefer to use the sine rule in right angled triangles instead of the standard trigonometric ratios.
Another misconception that students needed to be aware of is that the diagonal of a parallelogram is not an angle bisector or a line of symmetry. Many incorrect attempts stemmed from a mistaken belief that it is.

Question 5
One of the better attempted questions on the paper, testing a very standard procedure. Most students found this question very accessible and 60% gained full marks, with only a small minority score fewer than 4.
Part (a) was usually well done with, scoring all three marks. Where errors were made there were two main causes, which were incorrectly "multiplying through by 6" to simplify as a first step or incorrect treatment of the square root index. Writing $x^3/6$ as $6x^3$ or $6x^{-3}$ or similar errors were also noted, and in some cases -15 was not differentiated to 0.
Very few students integrated instead of differentiating.
In part (b) nearly all students attempted to substitute $x = 4$ into their derivaive to get the gradient and score at least the first mark. As noted, most then went on correctly to achieve the required answer, but there are still students who do not know the difference between tangent and normal and went on to use the tangent gradient and scored no further marks. For those attempting to change the gradient, the negative reciprocal was usually used, very few taking just the reciprocal. Some sign errors were made

rearranging the equation into the required form, and some candidates did not pay attention to the requirement that a, b and c were integers, while others lost the final mark by not including = 0 in their final answer.

Question 6

The distribution of marks scored for question 6 was consistent strikingly uniform, with the modal mark being full marks just ahead of 0 marks. The question thus proved another good discriminator allowing for the full range of marks being scored.
In part (a) there were a variety of responses seen. Most drew a correct shape for $y = k/x$ but not all consider had the correct translation, instead having either no translation at all or a horizontal shift. In some of these cases an asymptote was drawn and labelled as $y = k$ despite there being no translation! Some translated the graph up by k in the first quadrant only thus not getting an intercept with the negative x axis, while others drew the correct shape graph in the first quadrant only.
Most who had translated up did identify the asymptote correctly, but it was more common that the intercept was sometimes omitted or incorrect, such as $-4+k$. The equation of the asymptote was sometimes written as just k rather than $y = k$.
For part (b) the main scheme method was a little more popular than the alternative but both methods were common. By the main scheme students equated the equations but errors were often seen multiplying by x, the most common being getting $4 + \mathrm{k} = 10x - 2x^2$ by not multiplying k by x. Most were familiar with linking "tangent" to $b^2 - 4ac = 0$ and were successful solving the quadratic obtained, but there were a considerable number who wrote an inequality and found a range, rather than just the two end value, and this cost them 2 marks.
In the alternative method, the most common error was using the same x value with both y values when finding k at the final step, yielding 10 as the second value. These gained all except the final mark. It was also quite common to see only one answer being considered when square rooting.
A few wrote their answers for k as decimals rather than surds, thus losing the final accuracy mark. Again the need to keep to full accuracy is important.

Question 7

This question was very accessible in part (a) but was very much more mixed in response for part (b), while correct answers to part (c) were rare. There were some blank responses to the question, but most were able to score at least the two marks in part (a), though the calculation 2×4 was incorrectly evaluated on a few responses.
Part (b) was more testing and though it was answer well by many sutdents there were as many others who simply did not know what to do. A common answer was to substitute $(2+h)$ into the derivative from (a), yielding $4(2+h)$ as the answer. This did, in some cases, follow a correct statement of $y_Q = 2(2 + h)^2 + 5$, which was subsequently unused.
Among those who did attempt a correct chord gradient there were many algebraic errors that prevented the accuracy being awarded. Incorrect expansion of $2(2 + h)^2$ was common (usually forgetting to double the h^2 term), as was a sign error when simplifying $2 - (2 + h)$ in the denominator.
In part (c) the mark, which required a reference to the limit as h tend to zero, was rarely awarded. A common explanation of the link between parts (a) and (b) of the question was that 'the answer to part (b) is $2h$ greater than the answer to part (a)'. References to perpendicular lines were also seen. The combination of a correct answer to (b) followed by an incorrect answer to (c) suggests that whilst candidates know how to perform a proof by first principles, many do not understand the relationship between the gradient of the chord and the gradient of the tangent.

Question 8

This was the one of the most poorly answered question on the paper, along with question 9. . Almost half of the responses were either blank or scored no marks, while only a third scored full marks. Attempting to squre the equation by squaring each term in place was a frequent mistake and immediately led to the loss of all marks. Only a small number students attempted the alternative method correctly and rearranged before multiplying out brackets before solving the quadratic. However, those that did make the rearrangement requird initially did usually solve successfully via this method.

Students in general used wrong notation throughout and presented their solutions in a disorganised manner. A clear substitution such as $y = x^{1/2}$ was used by only a minority of the students, but there were many who did recognise the quadratic nature. The lack of a clear set out, though, meant that many of these stopped at finding the roots $3 \pm \sqrt{5}$,thinking this was the answer.

There were also a number of students tried multiplying the original equation by $\sqrt{x}$ in an attempt to get rid of $x^{1/2}$ and also many other responses that simply did not make any sense at all.

In this question, working was in evidence in most cases, but some students started their answer with the roots for $x^{1/2}$ with no evidence, and so lost 2 marks. The importance of showing working once again need to be stressed.

Question 9

Question 9 was seen to cause significant difficulties for candidates in this cohort, with well over half of the candidature scoring no marks at all on this question. This was disappointing to see, and shows that the graphs of the trigonometric functions and ideas such as the period are not well understood. Even in the higher grades it was uncommon to see more then one mark scored.

In part (a) the concept of the period was not shown to be grasped by many, with a range often being given rather than a value. There were some who identfied the 24π as a value at one end of the range, but this did not score the mark. Other common values to see were 12π, or $\pi/6$ or just 2π.

Part (b) was the most successfully answered part with coordinates (18π, -1) seen even from candidates who gained no other marks in this question. The positions of the turning points of the graphs seems to be understood even if the periodicity is not. As this was a follow through mark it was also gained by some with an incorrect period, ($\pi/8$, -1) following $\pi/6$ as period was common and allowed even if seen as part of an interval in part (a). But there were many candidates who worked in degrees instead of radians, and this forfeited this mark as the first (and only) mark to which they were due if an interval had been given in (a).

Part (c) of this question proved the most difficult for candidates to understand. Most commonly seen incorrect answers were $-\alpha$ for (c)(i) and $\pi - \rho$ for (c)(ii), but there were also many attempts at giving a trigonometric expression as an answer too, such as $\sin(\alpha)$. Trigonometry continues to be a topic of difficulty and the slightly unusual nature of this question proved too much for most students at all grades.

Question 10

Following from the previous two questions, this question proved much more accessible with many scoring full marks in parts (b) and (c). The basic algebraic manipulation of expanding brackets was a good source of marks and most students made an attempt at part (b) at least.

Part (a) was less well answered than the next two parts, with often just one mark scored. Most were able to identify one or both of $x = -5/2$, $x = 3$ as solutions to $f(x) = 0$, but not many then wrote both correct answers, as 3 was often rejected giving just $x \leq -5/2$ and gaining one mark. There was an expectation that the answer should be a range, not a single value. In contract some just left the answer as the two values $-5/2$ and 3, also scoring one mark, while others gave $-5/2 \leq x \leq 3$ gaining neither mark.

In may also be noted that many multiplied out f(x), not realizing that the given factorised form gave them the solutions, but they usually went on to solve correctly, probably from their calculator!

Part (b) was very well done. A few made errors in expanding, such as $(x-3)(x-3) = x^2 - 3x + 9$, or other numerical errors collecting terms, but in most cases this part was fully correct.
Part (c) was also well done, though (ii) was not quite so successful as (i). Most were able to obtained both marks following through on their answer even if part (b) did have an error, and most could identify the cooridinates of *P*. The gradient was found correctly in most cases, but there were some who differentiated and tried to solve the derivative equal to zero instead of reading off the gradient at zero.
Like part (a), part (d) had provided more of a challenge than the middle parts. Most showed a recognition that subtracting 2 was involved, but there were many who just subtracted 2 from their expanded equation in (b). Some others attempted to subtract 2 from each bracket rather than the x. And there were also those who applied $g(x) = f(x) + 2$ or $f(x + 2)$.
Of those who correctly considered $g(x) = f(x - 2)$, and substituted $(x - 2)$ for x in the factorised form of $f(x)$, some made numerical errors simplifying the brackets, or only simplified one bracket. There were also many who substituted $(x - 2)$ into the expanded $f(x)$ and these did not proceed to give the answer in a fully factorised form.
If the correct translation was applied, most gained the final mark in (d)(ii) mark, though few realized that the words " hence state" implied that no working was necessary to get the answer. There were many who multiplied out the brackets and substituted $x = 0$.

Question 11

Despite being at the end of the paper and structured in an unusual way, question 11 was well answered by the majority of students with the modal mark being full marks by quite some way. However, it was a good discriminator for the lower grade candidates, whoe often would not treat the constants of integration correctly.
Part (a) did cause its problems for many students, though, with many attempts starting by trying to find $f(x)$ before differentiating again in order to substitute $x = 4$ to get the gradient that was given in the question. There were also attempts using the negative reciprocal in this part, quite possibly from the same students who had found the tangent in question 5.
Once the gradient had been identified (either from the question or more roundabout working). the tangent required in part (a) was constructed confidently using the information in the question, with the majority of candidates using the form $y - y_1 = m(x - x_1)$ then rearranging to the required form $y = mx + c$. Candidates beginning by substituting the point (4, 32/3) and the gradient 5 into $y = mx + c$ then rearranging to find c were slightly less successful in producing a correct final answer.
In part (b) the integration was genrally performed well, even with negative and fractional powers involved, which is encouraging. A few did bring the negative index up incorrectly, but would usually deal correctly with the constant term in order to gain the method marks for integrating.
The most commonly lost marks were due to an incorrect processing of the two constants of integration produced in part (b). Having integrated $f''(x)$ a many either mistakenly substituted (4, 32/3) rather than (4, 5) in an attempt to find the first constant or did not include a constant of integration at all until after the second integration. Some did include the constant but continued to integrate again without attempting to find its value. In this case, marks could still have been gained for correctly processing their two constants of integration, provided they were labelled differently, though this was very rarely seen.

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