Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

January 2019

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

General

This was the first sitting of this unit as part of the reformed International A Level Mathematics qualification and it proved to be a good test of students' ability on the WMA11 content. There was plenty of opportunity provided for them to demonstrate what they had learnt and there was a lot of familiarity with the type and style of questions seen in previous WMA01 papers. There was no evidence that candidates were pressed for time, although examiners reported that several questions were left unattempted by candidates. There was not a pattern as to where these omissions occurred on the paper. Marks were available to students of all abilities and the questions that proved to be the most challenging were, 2, 4 and 5.

Question 1

This indefinite 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. Notation was generally used correctly, and it was uncommon for candidates to forget the constant of integration. The most common errors seen were $\frac{1}{2x^3}$ written as $2x^{-3}$ prior to integration and mishandling the fraction $\frac{2/3}{4}$ after integration of the first term. Candidates should be advised that a fully simplified answer requires a constant term to be integrated to ax rather than ax^1.

Question 2

The majority of candidates scored no marks, usually due to being unable to use laws of indices correctly for the right-hand side of the equation; insufficient working to deal with $27\sqrt{3}$ was usually the reason for this. Some candidates who applied the laws of indices correctly, set the powers equal and made y the subject did not achieve the final mark because they did not sufficiently simplify their expression. Some candidates did not achieve the second method mark as they incorrectly rearranged to make x the subject.

Question 3

Candidates' responses to this question demonstrated a good understanding of straight lines and their equations. In part (a) candidates recognised the need to rearrange the initial equation and obtain y as the subject to obtain the gradient, though an error seen by many examiners was the identification of the gradient of the line as $-\frac{3}{5}x$ rather than $-\frac{3}{5}$. Some candidates did not extract the gradient and so did not gain the final mark in part (a).

The perpendicular gradients rule was used correctly by the majority of candidates to form the equation of the line through $(6,-2)$. Candidates using the form $y-y_1=m(x-x_1)$ were generally more successful in achieving a correct final answer than candidates using $y = mx + c$ who then needed to solve an equation to find c.

Question 4

This was quite a straightforward question, although a new topic within the qualification. It was disappointing that only a minority of candidates gained full marks and a significant number seemed to be unfamiliar with the topic of identifying inequalities on a graph. There were a number of blank attempts.

Most candidates stated both $2y \le x$ and $y \ge 2x - \frac{1}{2}x^2$ correctly and the majority made an attempt to find the intersection of the curve with the x-axis, usually correctly finding the value 16. However, this was sometimes not followed by $x < 16$ or $x \le 16$. Stating $y < 16$ was a frequent error. Those candidates who gained no marks often solved the equation correctly but stated no inequalities. Others stated inequalities involving R, which gained no credit.

Question 5

This question proved to be a good discriminator as it tested a candidate's understanding of trigonometric graphs, radians and sketching graphs to solve problems. The absence of a scale on the $y = \cos 2x$ graph lead to some candidates not sketching $y = \sin x$ carefully enough in relation to the given graph. Most candidates were able to make a reasonable attempt at parts (a) and (b) of this question, but very few gained full marks.

(a) The majority of candidates gained both marks, although some of these gave $90°$ as the x-coordinate or $+1$ as the y-coordinate which was penalised.

(b) Many candidates were able to sketch $y = \sin x$, though some lost both marks for their maximum and minimum values not being the same as the $y = \cos 2x$ graph. Many lost the second mark because they missed the section where x is negative or sketched $y = \sin 2x$, or $y = \sin\left(\frac{1}{2}x\right)$. It was noticeable that many candidates did not mark a scale on the x-axis, despite part (a) encouraging them to do this.

(c) This was one of the most challenging parts for candidates with very few candidates showing any understanding that they should consider the intersections of the two graphs sketched. Of those who correctly answered 30 for part (i), a few incorrectly answered 31 for part (ii). Some understood that they had to multiply their number of intersections by 10 and this was usually seen when they had four intersections for their graph.

Question 6

The majority of candidates attempted this question and understood what was required, and about half of these achieved full marks. A few candidates integrated instead of differentiation in one or both parts of the question which scored no marks. It was evident that some candidates find the inverse process of indices particularly challenging which is needed to solve the equations of this kind.

(a) Most of the students found $f'(x)$ correctly and set $f'(x) = 0$ reaching $x^{\frac{3}{2}} = 8$, but finding the value of x from this equation was often found incorrectly.

(b) The majority reached the correct $f''(x)$, set it $= 5$ and made $x^{\frac{1}{2}}$ the subject. Some candidates failed to achieve the correct answer because instead of taking the square of both sides, they took square root instead.

Question 7

Overall this was an accessible question and the sine and cosine rules were applied correctly. Many candidates scored most of the marks available with many achieving full marks.

(a) The majority used the sine rule and achieved the correct acute angle. However, many failed to find the required obtuse angle. Some candidates worked in radians; candidates should be advised to work in the same angle measure which was degrees in this question (as shown by the $35°$ for the given angle).

(b) There was a variety of different ways of being able to find the length *AD*. Those candidates who had an acute angle for $\angle ACB$ would likely encounter, with correct subsequent working, an isosceles triangle that is not possible due to having two obtuse bases angles. However, alternative approaches meant that candidates could find AD correctly without needing to use their answer to part (a). The notation used was often spurious, incomplete or incorrect for the lengths being calculated which meant it was unclear whether the value of 8.2 (and in many cases a final answer of 24.1) came from correct working. Students should be advised to show sufficient working for all questions.

Question 8

This question was found to be a good discriminating question with the majority being able to score at least half of the available marks.

(a) Nearly all candidates attempted this part of the question. The vast majority of candidates correctly stated $y = 4$ for the asymptote of the reflection of $y = f(x)$ in the y axis. There was rarely any working seen but some candidates sketched the graph of $y = f(-x)$ correctly and labelled the asymptote on their new graph, which was acceptable.

There was a significant number of candidates who stated $y = -4$. It is unclear whether this was a misunderstanding of which axis the graph was being reflected in.

If candidates stated more than one equation, for example $y = 4, x = 0$ this was not condoned and the candidate was not awarded the mark.

(b) The vast majority of candidates stated $(16, 9)$ as the coordinates of the turning point.

A few candidates sketched the graph of $y = \mathrm{f}\left(\frac{1}{4}x\right)$ correctly and identified the turning point on their new graph which was perfectly acceptable.

A small but significant number of candidates misunderstood the transformation and divided the *x*-coordinate of the turning point on $y = \mathrm{f}(x)$, giving $(1, 9)$ as their answer. A disappointing number of students gave the coordinates of the turning point and the intercepts; if the turning point was not actually identified as such, the mark was not awarded.

(c) This was the least successful part of this question which was often omitted. Many of the candidates who attempted to find values for *k* either stated $k = 9$, stated $k < 4$ only, or gave their answer in terms of *y*. Very few candidates successfully realised that a horizontal line would intersect at only one point with the curve at the turning point ($k = 9$) and for any value of *k* at or below the asymptote ($k \leq 4$).

(d)(i) This was answered well by the majority of candidates, with almost all of them simply stating $a = 6$.
A common incorrect answer was for candidates to state $a = -6$ although this was condoned if $\mathrm{f}(x) - 6$ was seen in their working, this was condoned as a slip.

(d)(ii) This part of the question was also answered successfully by the majority of students with most choosing the single transformation of translating the graph 3 units in the positive *x* direction i.e. $y = \mathrm{f}(x-3)$.

A common slip was to just write $\mathrm{f}(x-3)$, which is not the equation of the transformed curve and the mark was not awarded. Another common error was to give the equation as $y = \mathrm{f}(x+3)$, which may have been a misunderstanding of the horizontal transformation functions, or a slip.

Question 9

This question proved challenging for some candidates, who failed to realise that they needed to a form a quadratic in *x* in order to use the discriminant and therefore scored no marks.

Candidates who began by multiplying through by *x* were generally successful in moving the terms to one side and isolating the correct values for *a, b* and *c* to use in the discriminant, although sign slips were not uncommon. Examiners occasionally saw responses in which all terms except *c* were multiplied by *x*. This led to a discriminant which was linear in c and limited further progress could be made.

Most candidates who reached a quadratic in *c* chose to use the quadratic formula to find critical values. The need to solve an inequality was well understood and the majority of candidates attempted to state the 'inside' of their critical values for *c*. Despite a few candidates resorting to *x* at this stage, *c* was maintained in the majority of cases. Candidates should be advised that unless stated otherwise, exact solutions to quadratics are expected.

Question 10

This question testing radians, sectors and perimeter was attempted by a majority but few were able to achieve full marks.

(a) This part demonstrated that a large majority know the formula of the area of a sector but writing its perimeter was more challenging for them, as some used the formula for just the arc length. Most were able to score the first two marks, but achieving the given answer was very difficult for most candidates as many made errors in the manipulation to make *r* the subject in one of their equations.

(b) The candidates who were able to get full marks in part (a) achieved full marks in this part as well. Most of the ones who did not manage to get the printed answer in part (a), surprisingly, did not make any attempt in this part.

Most of the candidates who calculated the values of θ, either used the quadratic root formula, factorisation, or possibly used their calculator. Very few used the completing the square method. The question said "hence" which suggested that candidates should use the given answer in (a) to help them in (b). Some candidates found an equation in *r* and solved this to then proceed to find the associated angles.

Question 11

The was a question that produced a wide range of marks. Most were able to score more than half of the available marks, however, very few were able to score full marks.

(a) The majority of candidates scored at least two marks for their sketches. Common errors included sketching positive quadratic or cubic graphs or sketching their graphs to pass through the negatives of the actual values. Some candidates did not label their intercepts.

(b) This was usually well answered with the majority of candidates scoring at least two marks; those losing the final mark was usually due to either bracketing slips, having incorrect lines of working that were not corrected or arithmetic or numerical slips including sign errors.

(c) Many candidates were able to use the answer in part (b) and proceed to solve the quadratic equation. There was a significant proportion of candidates, however, who did not attempt this part.

The question clearly highlighted the need to use algebra and show working which candidates did not appreciate in nearly all cases. Candidates were usually successful in finding the required *x*-coordinate, but marks were lost in finding the associated *y*-coordinate by not showing sufficient work dealing with the surds and just substituting into their calculator. Candidates should be advised to show their working wherever possible and pay particular attention to instructions within questions that emphasise such aspects.

Question 12

Overall, this question was answered well by most candidates but there was an issue with candidates showing their work for part (b) but labelling it part (a) and vice versa. Candidates are advised to label their work clearly so that they can be rewarded for proceeding towards an answer.

(a) The vast majority of candidates successfully substituted $x = 4$ into the given expression of $\frac{\mathrm{dy}}{\mathrm{dx}}$ to find the gradient of the tangent to the curve at *P*. Almost all candidates achieved the correct value of 19. The most popular approach following this was to establish the equation of a straight line with gradient 19 passing through $(4, -2)$. For the few candidates who were not successful, many reached the equation of the line but made errors with arithmetic.

A small number of candidates did not realise that they had already been given the derivative and began by differentiating the given expression. Occasionally, candidates tried to simplify $\frac{\mathrm{dy}}{\mathrm{dx}}$ and made an error with the power of the term $3x\sqrt{x}$.

(b) The vast majority of candidates successfully integrated the given expression for $\frac{\mathrm{dy}}{\mathrm{dx}}$. Common errors were to make arithmetical slips when simplifying the coefficients, omitting $+\mathrm{C}$ or making a sign error with the term in $x^{\frac{1}{2}}$. Other candidates made errors in preparing $3x\sqrt{x}$ as a single power prior to integration or failing to substitute the given coordinates after reaching their integrated expression with $+\mathrm{C}$ in it.