Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

January 2024

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

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Question report WMA11 January 2024

This January's sitting of WMA11 module was popular, attracting some 17 800 candidates. Most were well prepared and made good attempts at all questions. Questions 1, 3, 5, 6 and 8 provided a useful source of marks for many. The better prepared and more able candidate was able to show their skills in the more demanding questions of 7, 9 and 10. Centres should take note that questions on proof are still being found difficult. Question 4(a) was not well attempted and many candidates failed to show sufficient working on 8(a). Points to note for candidates in future WMA11 series are:

- failing to add + c when integrating will lead to the loss of a mark
- read questions more carefully and sketch a diagram if it will help (Qu 2)
- pay attention to questions where calculators are not allowed (Qu 4)
- ensure that you show sufficient working to make your method clear
- be careful when sketching curves, show the key aspects of the curve
- label parts carefully and answer the question that is being asked (Qu 10)

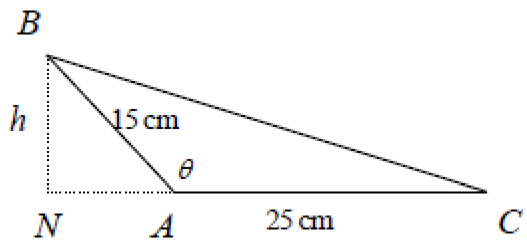
Question 1:

Most candidates seemed prepared for such a question and knew the basic method. This involved expanding $(2x-5)(3x+2)(2x+5)$ to a cubic polynomial followed by the integration of each term. Marks were generally lost for errors when expanding the brackets, although a few did not know how to integrate, and differentiated instead. It was however a gentle start to the paper and many scored full marks.

Question 2:

This question required candidates to find angles and lengths within an obtuse angled triangle using trigonometry. As with other questions where a diagram isn't given, a good tip would be to sketch out the figure adding the lengths and angles as appropriate.

In part (a) most candidates proceeded to find $\sin\theta° = \frac{8}{15}$ via the method seen in the mark scheme using the area formula $A = \frac{1}{2}ab\sin C$. More demanding methods were seen, usually from attempts using Pythagoras' theorem on the triangle (see below). Unfortunately many of these came up short, especially in part (b) as θ was often made acute.



In part (b) many knew that the cosine rule was required and it was often used correctly, reaching the answer 38.5 cm. The most common issue, and it occurred many times, was the number of candidates who solved $\sin\theta° = \frac{8}{15}$ and used an angle $32.2°$ and not $(180-32.2)° = 147.8°$

Other common errors seen were:

- candidates who used $\theta = 90 + 32.2 = 122.2°$ as their obtuse angle
- candidates who made an error on the cosine rule using incorrect variations such as $BC^2 = 15^2 + 25^2 - 2\times 15\times 25\times \sin 147.8°$ or $BC^2 = 15^2 + 25^2 - 15\times 25\times \cos 147.8°$

Question 3:

Overall, this was another accessible question for which candidates seemed well prepared.

In part (a), most candidates chose to split the given fraction up into two simple fractions before differentiating. Common errors seen here were:

- writing $\frac{5x^3 - 8}{2x^2}$ incorrectly as $\left(5x^3 - 8\right)\times 2x^{-2}$ before expanding
- differentiating the x^{-2} term to x^{-1}

Where candidates used the quotient rule it was usually done well.

In part (b), most candidates scored at least two of the three marks for finding the value of their derivative at x =2 and using this gradient and the point (2, 4) to find the

equation of a straight line. If mistakes were made here, it was either in transposing the coordinates in their substitution, or else in finding the gradient and equation of the normal.

Question 4:

Part (a) proved to be more of a challenge than expected. Whilst the better candidates achieved the proof with ease, weaker candidates found it difficult to relate 4^x, 2^{x+3} and 2^{x-1} with $p = 2^x$

. Quite often 4^x was set equal to $2p^2$, perhaps with one eye on the given answer. Other errors seen included setting 2^{x+3} equal to $2^x + 2^3 = p + 8$ and rather more surprisingly, omitting the "= 0" in the proof.

Part (b) was found less demanding than part (a) but many lost mark for using their calculators. This was a non calculator question and many merely stated

$4p^2 - 33p - 8 = 0 \Rightarrow p = \frac{1}{4}, 8$ without any working. The mark scheme allowed these candidates to score the final two marks in the question. Other common errors seen in this part included

- candidates who felt that they had solved the question after finding values of p
- candidates who mistakenly rejected $x = -3$ as presumably it was a negative answer

Question 5:

This was another question that required sight of all the relevant steps in working as well as the use of non calculator methods. Lack of working was especially evident in parts (b) and (c).

In part (a), candidates were expected to find the equation of a line given the coordinates of two points that lie on it. Most proceeded via the main method on the scheme by finding, firstly, the gradient. The majority found this successfully and went on to find the equation in the correct form. Errors in this part can be summarised as follows:

- candidates who attempted the gradient via $\Delta x / \Delta y$
- candidates who made arithmetical slips in finding the equation in the form $y = mx + c$

In part (b), candidates were required to find where the perpendicular line through the origin, $y = 4x$, intersects with the original line. Whilst most showed their method including the necessary steps, there was a sizeable minority who either gave just the answer following $y = 4x$, or merely wrote down (b) (4, 2) with no evidence whatsoever. Both of these approaches were penalised.

There were many approaches to part (c) as evidenced in the mark scheme. The one in the main scheme was seen the most. The majority scored at least one mark for an attempt at the length of *OR* or *PQ*. There were many excellent solutions that showed an appreciation of the need to obtain a result without a calculator involving the use of $\sqrt{17}$'s. Marks were generally lost in part (c) where

- candidates merely wrote down $\frac{1}{2} \times \sqrt{153} \times \sqrt{68} = 51$ without any non calculator approach

- candidates used an incorrect method to find the area. E.g. $\frac{1}{2}\times OP\times OQ$

- candidates used the cosine rule to find the angle *POQ* which generally involved a calculator approach

Question 6:

This was a relatively accessible question on the trigonometric graph of $y=5\cos x$ and transformations on it.

Part (a) involved selecting a particular minimum value on $y=5\cos x$ and was standard bookwork for the well-prepared candidate. Many candidates scored full marks.

Part (b) involved finding maximum points when transforming $y=5\cos x$ to $y=5\cos x-2$ and $y=-5\cos x$ respectively. Whilst more demanding than part (a), many candidates did score at least half marks here. Errors, when made, were mainly due to:

- treating $y=5\cos x-2$ as $y=5\cos\left(x-2\right)$

- thinking that the maximum point on $y=-5\cos x$ would have a *y* coordinate of -5

Question 7:

Overall, this question on graphs and intersections was either done very well or very poorly thus discriminating higher achieving candidates from the rest.

In part (a) most candidates managed to score the M mark for an acceptable shape of curve in

quadrant one. However it might be the case that candidates underestimate the term 'sketch' and should offer more care than what could be described as a 'rough sketch'! Fewer candidates were able to score the A mark not least as a result of have their vertical asymptote at either *x* = – *k* or *x* = 0. The B mark for cutting the y-axis at – 4 / *k* was achieved by a good proportion of those candidates who had scored M1A1. Whilst the wording of the question required the equation of the asymptote as part of the sketch most candidates did show a dotted vertical line. The risk in not doing so is that the two branches of the curve may inappropriately 'overlap' vertically.

In part (b) many less able candidates made little or no attempt. Where an attempt was made virtually all equated the equations for C and the straight line to achieve a quadratic expression. Sign errors and a failure to reach an expression of the form f(x) = 0 were quite common at this stage. Most candidates went on to make use of the discriminant but earlier sign errors as well as failure to reach f(x)=0 meant that only the more able went on to achieve the correct quadratic in k. Those who reached the statement $k^2 - 18k + 65 < 0$ almost always went on to achieve a correct expression for the range of values of k.

Question 8:

This question tested the use of the formulae for both the arc length and area of sector of a circle. The vast majority of candidates knew these formulae and attempted to use them. There were some candidates who instead of using the standard formula $\frac{1}{2}r^2\theta$ for the sector area, used the equivalent $\frac{1}{2}rl$ where l is the arc length which was acceptable. A minority chose to work in degrees and this was also acceptable providing the correct formulae for those units were used and the angles were converted to degrees.

Candidates could usually deal with the ratio in part (a) in order to find AO. There were attempts which never referenced AO or other acceptable lengths in order to link the working into the question and these lost the final A mark. It was important for candidates to show the necessary steps as this was a given answer. Just writing down a few calculations without referencing what they were, and why, led to a loss of marks.

In part (b) most candidates knew that they needed to find the length of the major arc. Most were successful in this although a sizeable minority could not find the necessary angle. Rounding errors were also common in (b) with for example, 55.98 rounded to 56.1and 55.9898 rounded to 56.09.

For those who attempted part (c), almost all gained at least one mark for the area of one sector. Again it must be emphasized that method is important. There were candidates who just stated an answer in parts (b) and (c) which is not acceptable. Examiners need to see how the answer has been derived so the minimum expectation in parts (b) and (c) was

$$\text{Perimeter of platform } = 9 + 2\times(11.25 - 7.03) + 7.03\times(2\pi - 0.8) = 56.0\text{ m}$$

$$\text{Area of platform } = \frac{1}{2}\times\text{"}11.25\text{"}^2\times 0.8 + \frac{1}{2}\times 7.03^2\times(2\pi - 0.8) = 186\text{ m}^2$$

Question 9:

Question 9 produced some outstanding solutions from high achieving candidates. Others struggled to do anything bar sketch a quadratic curve in part (a). It was a highly discriminating question producing a wide range of responses.

In part (a) candidates were required to sketch a quadratic curve given certain information. Many achieved the first mark for a negative quadratic (upside down parabola) passing through the origin. The second mark was not achieved by as many as they failed to consider the second intersection with the x-axis.

In part (b) candidates needed to find the equation of the quadratic. Numerous approaches were possible, using the roots, the turning point or else via $y = ax^2 + bx + c$. Common errors in all three approaches were candidates who set the coefficient of x^2 to be 1. Those that started with the roots $y = \pm Ax(x-4)$ or via the turning point $y = 20 \pm C(x-2)^2$ generally did better and most had a reliable method of finding A or C.

Part (c) was another question that demanded some working. The demand was

"Given that the x coordinate of the point P is negative,

(c) using algebra and showing all stages of your working, find the coordinates of P. (5)"

Merely writing down $x\left(x^2-4\right) = -5x(x-4) \Rightarrow x = -8 \Rightarrow P = \left(-8, -480\right)$ should never be considered sufficient for 5 marks. Good candidates showed the necessary steps of firstly producing a cubic equation, followed by the quadratic before solving it and selecting the correct root. Candidates who produced a quadratic in (b) that did not pass through O could not score any marks in this part.

Question 10:

The majority of candidates made their working clear in this question but there was a sizeable minority who failed to label the parts to their work and made numerous incorrect attempts by differentiating f '(x) and calling it f (x) or f '(x). This was a problem-solving question and it was important for candidates to use a correct method in the correct part.

In part (a), most candidates scored at least two marks, either M1 A0 M1 A0 or else M1 A1 M0 A0. Many candidates differentiated f '(x) correctly and set up the correct equation, but either solved it incorrectly or did not give an exact answer. A common error was to set their equation equal to $8\sqrt{2}$ instead of zero. Some candidates integrated instead of using differentiation.

In part (b), most candidates scored at least two marks for the integration. Many candidates did not score the final two marks because their k from part (a) was not a multiple of $\sqrt{2}$. Candidates who did achieve in this question often went on to score all 8 marks and were the most able of candidates taking this paper.

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