Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

Summer 2025

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In Pure Mathematics P2 (WMA12) Paper 01

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General

This paper had a varied set of questions covering the specification for this unit, and it was pleasing to see candidates were able to make attempts at all the questions. There were many familiar types of questions, so candidates should have felt prepared had they completed past papers. There were some questions which candidates found particularly challenging, however, namely Questions 5(b)(ii), 7(b), 9(a) and 10. The paper provided good discrimination across all candidates and all abilities should have been able to demonstrate what they could do.

Report on individual questions

Question 1

The first question of the paper tested the binomial expansion which was a good opportunity for most candidates to score the majority of the marks.

Part (a) was generally done very well with candidates mostly using the $(a+b)^n$ form of the binomial expansion where *n* is a positive integer rather than $(1+x)^n$ where *n* is a rational number. Candidates managed well with the $-4x$ and generally produced the correct 4 terms. Some lost marks by leaving it in the form of $1+-28x+336x^2+-2240x^3$ and not fully simplifying it. Others lost marks by leaving 1^7 at the start and not just writing 1. There were some candidates who did not know how to use the binomial expansion and got no marks on this question, whilst others tried to multiply out the brackets but were not successful with this method as it gets complicated very quickly.

Part (b) was less well done. Many got it correct by realising where the two x^2 terms had come from and understanding that the coefficient is just the number part so did not write down the x^2. Others did write the x^2 and then cancelled it and proceeded to the correct answer. Some multiplied out the whole of the bracket and then extracted the x^2 terms and successfully equated them to 1316. There were many, however, who thought there was just one term involving *k* and got $k=-\frac{1316}{28}=-47$ and scored no marks. A few set the x^2 terms = 0 rather than the value given. Others did not cancel the *x* terms and scored no marks and made no further progress with the problem as they still had x terms attached to the $-28k$ and 1680 but not the 1361, and could therefore not calculate k.

Question 2

This question on circles was accessible to nearly all candidates with most scoring some or full marks in part (a). Part (b) was a less standard question which proved challenging for the majority of candidates.

Part (a) involved finding the equation of a circle given the coordinates at both ends of a diameter. Most candidates successfully found the coordinates of the midpoint of the diameter. A few erroneously subtracted the coordinates of the end points instead of adding them (before dividing by two) resulting in incorrect coordinates. The majority of candidates also realised they had to use the distance formula with most choosing to apply it to the end points of the diameter. This caused issues for some as they did not recognise that they had found the diameter (or diameter squared) and treated it as though it was the radius (or radius^2). This misunderstanding meant they lost at least three of the five marks for this part. Some others confused their x and y coordinates, and sign slips were not uncommon when finding the distance. This lost them the method first mark as it implied they were not using a correct formula. There were, however, many successful candidates who went on to give the equation of the circle correctly and gained full marks. Some candidates did not understand what the question was asking and instead found the equation of the radius, or the tangent at one of the given points.

Part (b) involved finding the exact coordinates of the point on the circle that is nearest the x-axis. Apart from a small minority of candidates who could visualise the problem and simply wrote down the answer, the most progress was made by those who drew a diagram. This enabled many of them to realise that the point was simply one radius length below the centre of the circle. Some candidates correctly realised that $x = 1$ at the required point and then used algebra to find the y coordinate using their circle equation. However, many of these candidates did not reject the y-value which represented the point furthest from the x-axis. For those who did not draw a diagram, some appeared to think the question was asking them where the circle intersected one of the coordinate axes and they set x or $y = 0$ and used their circle equation to find the other coordinate. Sometimes this was because of an incorrect circle which changed the demand of the problem and scored neither mark in (b). Many made no notable attempt at all, and it was not uncommon for no marks to be awarded here.

Question 3

This question assessed candidates understanding of finding the area between lines. The question was accessible to most candidates who attempted this question with partial if not full success.

The first three marks of this question candidates were generally successful in scoring. Some candidates, however, did not know how to deal with the additional line and just found the area under the curve.

The majority of candidates integrated the given curve and found the area underneath it. They then found the area of the trapezium (either using the formula or finding the area of a rectangle and triangle) and subtracted the area under the curve from this. Loss of marks through this method was usually from not using the coordinates correctly to find the area of the trapezium which saw them not receive the final method mark.

Some candidates found the equation of the line and found the area underneath it in the correct interval, instead of finding the area of trapezium geometrically, then subtracted the area under the curve. As long as they used the correct interval, this method was often successful. Some made mistakes finding the equation of the line which lost them the accuracy marks. Candidates who subtracted the curve from the equation of the line before integrating and substituting in their values were generally successful. Some lost marks through their algebraic manipulation or not using the correct limits. This was a more time-consuming approach requiring either five terms to be integrated or terms to be collected resulting in occasional sign errors. In addition, the incorrect equation of the line would result in finding the wrong area. Occasionally the upper limit was seen as 5 rather than 4. It was pleasing to see that most candidates heeded the warning and showed clear substitution of limits and stages of calculation. Some candidates chose to find the area using curve-line. Where this did happen, not all candidates clearly demonstrated that they understood that the area had to be a positive value. The use of modulus signs to avoid this issue was rarely seen.

Question 4

Knowledge of the Factor Theorem and Remainder Theorem were well applied in this question.

In part (a) most were able to use the factor theorem by substituting $x = -3$ into the function and equating to 0. The arrangement of the resulting equation given was a mere formality for the majority. However, too many candidates failed to use the factor theorem correctly, i.e. failing to set their $\mathrm{f}(-3) = 0$ from the outset, and hence either lost a mark or both available marks. Less efficient attempts via polynomial division were occasionally seen, and typically unsuccessful.

In part (b) the question was generally well handled but there were a few who did not know how to use the remainder theorem to find the second equation and mistakenly set $\mathrm{f}\left(\frac{1}{2}\right) = 0$. The second method mark was for solving two equations and the vast majority gained the correct values for *a* and *b* although surprisingly few used their calculators for this. Once again, the occasional less efficient attempts via polynomial division were typically unsuccessful.

On the other hand, those who attempted long division in part (c) were highly successful apart from the occasional sign slip. The majority seemed unable to identify the quotient and remainder but were given marks for their embedded values. Of those who started by using the remainder theorem to find the remainder few were able to continue via synthetic division to find the quotient. Nor did they think to use their remainder to check their long division.

Question 5

The trapezium rule was well known by most candidates.

Part (a) was answered correctly by a substantial majority of candidates who went on to get all three marks. Typical errors came from those who tried calculating *h* using the formula $h = \frac{b-a}{n}$ and mistakenly taking *n* as the number of strips instead of the number of ordinates. Occasionally incorrect bracket structure was used such as $\frac{1}{2}h\left(y_0 + y_n\right) + 2\left(y_1 + y_2 + ... + y_{n-1}\right)$ meaning only the first and last *y*-coordinates were multiplied by $\frac{1}{2}h$. A small minority tried to complete this question by using a combination of integration and the trapezium rule.

In contrast to part (a), part (b) proved to be the most difficult for candidates with very few gaining any marks. In part (i), several candidates recognised that this was some multiple of their answer to part (a) but incorrectly calculated the multiplier as $\frac{3}{4}$. $\int 3\left(\frac{1}{2}\right)^2 \times 3\left(\frac{1}{2}\right)^x \mathrm{d}x$. In part (ii), some candidates reached the point of $\frac{18.8}{3}+\int 2x\,\mathrm{d}x$ but then failed to integrate $2x$ and substituted the limits into $2x$ instead of x^2. Others did not show sufficient method to score the mark with a requirement to see either the integrated expression, or the limits embedded.

On the rare occasion some re-did the trapezium rule in part (b) which gained no marks as the question had insisted on using their answer to part (a). This would also have been detrimental to their timing.

Question 6

This question tested manipulation of logarithmic functions. Part (i) was answered well by the majority of candidates; part (ii) proved challenging with candidates scoring only the first method mark.

The questions carried the now common instructions to show all stages of working and also not to rely on calculator technology. Marks were lost because these instructions were not followed.

In part (i), most candidates could apply a correct law to begin with. The most common first step was to see $2\log_2(4-x)$ rewritten as $\log_2(x-2)^2$. Other first steps less often seen were $\log_2\left(\frac{x+11}{2}\right)$ written as $\log_2(x+11)-\log_2(2)$ or 3 written as $\log_2(8)$.

The next step of combining two terms of the original equation was usually done correctly but there were instances of incorrect logarithmic work seen such as $\frac{\log_2(A)}{\log_2(B)}=\log_2\left(\frac{A}{B}\right)$ which failed to gain credit.

On reaching a quadratic equation and solving it, the wording of the question required the method to be shown. Marks were lost by those who used a calculator and just wrote the roots down. The method of solution most used was by factorisation; next most common was the use of the quadratic formula; and lastly completing the square. Factorisation solutions had to be convincing so that $2x^2-24x-56=0$ followed by $(x-14)(x+2)=0$ leading to the correct pair of roots did not gain credit. A final mark was lost in (i) because the root $x = 14$ was not rejected as it would have resulted in logarithms of a negative number.

Part (ii) of this question was not well answered. Candidates could usually form an initial equation, and this was usually in terms of x with solving for y first only rarely seen. Writing 6×3^x as 18^x was often seen as the next step with the loss of all subsequent marks. Also taking logs of both sides, to any base, led to errors such as $\log(6)\times\log(3^x)$, $2x+1\log(3)$ with brackets missing that were not subsequently recovered, all of which led to a loss of marks.

The instruction to not use calculator technology was not understood as responses resorted to decimals. This, too, lost most of the marks in this part of the question.

<u>Question 7</u>

This question on sequences proved to be one of the more challenging questions on the paper. It was rare for full marks to be achieved, particularly due to part (ii).

Part (i)(a) was very well done with candidates correctly finding r and then using the sum to infinity formula and obtaining 50. A few divided the wrong way and got $r = 1.25$ which does not produce a converging series, so this scored no marks.

Part (i)(b) was generally set up correctly but quite a few misread the number of 0 digits, but this still meant they could pick up the 2 method marks. A few tried to use the sum of a geometric series rather than the term formula. Mistakes were often made rearranging the formula and multiplying incorrectly the $10\times0.8^{k-1}$ to make 8^{k-1}, however method marks could still be achieved by correctly solving an equation of the form $p^x = A$. Many errors were made solving this type of equation but the most common was to correctly solve the equation and then as $\log(0.8)<0$ they did not change round the inequality sign so ended up with $k < 45.38$ rather than $k > 45.38$ and even with $k = 46$ lost the last accuracy mark. Candidates did much better when they just used an = sign and then at the end worked out $k = 46$.

Part (ii) was poorly done with many candidates going straight to the arithmetic sum formula but then got no further and no marks because they did not have a value for n. A few did differentiate and set $\frac{dS}{dn} = 0$ and found n, some completed the square but then did not understand they needed the turning point so made no further progress. Some substituted in a decimal value for n, but n is a term number, so an integer was required so no marks were awarded in this part in these cases. Those who realised they needed to find the last positive term and set the formula > 0 or = 0 did succeed in finding a value for n and those who realised it had to be an integer then went on to successfully solve the problem using the arithmetic sum formula and find the largest sum. Some found the last term and used $\frac{n}{2}(a+l)$ formula.

Question 8

This question on solving trigonometric equations was done well by many candidates with a variety of marks being awarded. The second part was the most accessible with full marks regularly awarded.

Part (i) involved solving a single term trigonometric equation (in radians) with a compound angle. While many candidates competently solved the equation and gave the two correct values for x, this question part did not prove straightforward for many. Some did not recognise that they should isolate the $\tan\left(2x+\frac{\pi}{5}\right)$ term before attempting to take arctan of the resulting constant on the righthand side of the equation. Some made other initial errors such as distributing the coefficient of the tangent term throughout the angle resulting in $\tan\left(6x+\frac{3\pi}{5}\right)$ which also resulted in no marks. Of those who correctly reached $2x+\frac{\pi}{5}=\frac{\pi}{6}$, most were able to apply the correct order of operations and reach one valid solution, most commonly $\frac{-\pi}{60}$. Many of these candidates recognised that this was out of range and they went on to find one or both angles within the given range. Others did not or could not make further progress. A few did not take note of the required form of the answer $k\pi$ (with k rational) and used decimals. There were also candidates who worked in degrees, also leading to marks lost.

Part (ii) involved solving a trigonometric equation (in degrees) via a three-term quadratic equation in $\cos\theta$. This question part was standard, and almost all candidates started correctly by rewriting $\tan\theta$ as $\frac{\sin\theta}{\cos\theta}$. The majority of these candidates recognised they needed to multiply their equation by $\cos\theta$ to remove the denominator from the lefthand side. However, some only multiplied one of the two terms on the righthand which meant they would not be able to reach a three-term trigonometric quadratic, and they could gain no further marks. Most candidates also realised they needed to replace their $\sin^2\theta$ term with $1-\cos^2\theta$ and this was carried out well. For those who obtained a three-term quadratic equation in $\cos\theta$, they were able to use their calculators to solve it for $\cos\theta$ and then obtain a value for θ. Some candidates rounded the exact solution for $\cos\theta$ to 3 significant figures which caused rounding errors when finding θ and a loss of the final accuracy mark. Candidates need to be aware that they should retain sufficient accuracy with intermediate values to be sure of final accuracy. Some candidates also neglected to find the second value for θ in the given range losing the final mark.

Question 9

This question tested knowledge of the properties of 3D shapes and applications of integration. In general candidates found the question challenging and it was rare for full marks to be achieved. The biggest hindrance for candidates was a lack of understanding about the construction of 3D shapes (nets) and issues with finding areas of triangles.

Part (a) should have been the most accessible part of the question. However, many candidates really struggled to recognise that they could create a volume equation to find an expression for L. This could then be used to derive the required formula for surface area. Since the question stated that $S = Px^2 + \frac{Q}{x}$, the candidates knew what they were working towards It is really important in such a question to clearly set out a strategy, which could include drawing a net, to ensure that they had fully understood how to approach the question.

It was common for candidates to treat the prism as closed despite the diagram and statement that it was open. This created an extra area to consider and in addition many took both rectangles to have an area of $2xL$. Candidates who were able to create a formula for the volume did not all go on to rearrange for L. One common error was to not divide by 2 when finding the triangular cross section in the volume calculation. This led to $L = \frac{2}{x^2}$ instead of $L = \frac{4}{x^2}$. A mistake that was then carried through to the final formula for S.

Candidates also struggled to find a formula of the correct form for the surface area. The mark for this formula allowed for errors in coefficients but it had to be the sum of a squared area (the triangles) and the sum of areas of the form αxL

In part (b), often the first two marks were gained because they 'follow through' from part (a), and a small number of candidates worked with P and Q algebraically. Many candidates were able to pick up the first three marks for this question. It was very common to see no calculation for the surface area, S, which meant candidates were unable to access the last 2 marks. It was widely noted that many candidates struggled to correctly find a value for x. A few achieved a negative value but failed to realise that this was an impossible answer. A great many inaccurate values for x were found through an inability to accurately manipulate powers of x. Square rooting instead of cube rooting and inaccurate rearrangement. Whilst this was not penalised it highlights an area which clearly requires improvement. Occasionally candidates tried to follow through an answer to part (a) which was not in the correct form, meaning their derivative was not in the correct format either and leading to no marks being awarded.

Candidates who attempted part (c) were generally able to differentiate their equation from part (b) successfully to find the second derivative. Candidates generally understood the concept required to prove that the point was a minimum with almost all who attempted this doing so by finding the second derivative. Due to errors in part (a) very few candidates scored both marks.

A small minority of candidates considered the change of sign of $\frac{dS}{dx}$.

Question 10

Proof by exhaustion has been tested before in this syllabus and there is an improvement in the standard of work for this type of question. There are still candidates who proceed by substituting values into the given expression from the start and thus gain no credit.

Candidates could find expressions for m that were not multiples of 3 to begin the proof. $3k + 1$ and $3k + 2$ were the commonest expressions chosen but others such as $3k - 1$ and $3k + 4$ were used. As long as the two expressions used did not duplicate non-multiples of 3 then they were acceptable. Expressions such as $3k^2 + 1$ and $6k + 1$ were used but gained no credit.

The substitution of the chosen expressions into $m^2 + 3m + 2$ was usually done well with only minor slips in algebra preventing successful completion. Factorising out a factor of 3 to show that the expression reached was a multiple of 3 was the most common next step. There was some attempt to explain that each term was a multiple of 3 and hence the sum of the terms was similarly a multiple of three. Candidates should be encouraged to go for the simplest approach.

As in previous series, this type of question often loses the final mark because a final over-arching conclusion is not stated. It is not sufficient to leave a solution where both cases are said to be true as typically there needs to be a final conclusion such as “the statement is true”.

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