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Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

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

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General

This paper proved to be a good test of candidates' ability on the WMA11 content and plenty of opportunity was provided for them to demonstrate what they had learnt. Candidate did find number of questions challenging, although they did not seem to find time to be an issue. Marks were available to candidates of all abilities and the questions that proved to be the most challenging were 2, 6 and 8.

Report on Individual Questions

<u>Question 1</u>

This was a very typical and accessible question to start the paper with the vast majority scoring 3 or 4 marks.
Candidates were nearly all successful in being able to increase at least one of the indexes by one and $-5x$ was seen in nearly all cases. This even included some candidates who appeared to differentiate some terms and integrate others. Usually candidates were able to achieve $\frac{2}{3}x^4$, but the second term proved to be more challenging. Many candidates struggled to deal with the coefficient of $-\frac{1}{2}$ with the 2 ending up on the numerator instead before integrating. Other candidates made errors dealing with the negative fractional power of the second term. There were still some candidates who omitted the constant of integration at the end and some made errors with simplifying their coefficients. Whilst not penalised on this occasion, there were still a number of candidates who used poor notation; this included the integral sign and d*x* remaining as part of their final answer even though they had integrated.

<u>Question 2</u>

This question proved to be challenging for many of the candidates and was one of the most difficult ones on the paper. It was clear that candidates are still uncomfortable with the manipulation of expressions which involve a lot of work with indices.

In part (a), candidates were usually successful in achieving the correct answer, but for many this was all the marks they scored in the question.

In part (b), some were able to apply the addition law to extract the y term, but many did not achieve the correct answer. Errors were made with manipulating the expression, particularly due to the terms being on the denominator.

Part (c) was unattempted by a large number of candidates, whilst those who did attempt it, were unable to see how they could progress from 9^{2-3x} to a term which had 3^x and scored zero marks as a result. Due to the nature of part (b) and (c) it was unusual for any candidates to pick up any marks in (c) had they not been successful in part (b).

Question 3

This question proved to be a good discriminator between weaker candidates and more able candidates.

Weaker candidates generally were only able to gain full marks in part (a). Most candidates recognised that they needed to differentiate and obtained $\frac{\mathrm{d}y}{\mathrm{d}x} = 2x + 3$ and substituted $x = 3$ to obtain the correct answer. However, some candidates only scored the method mark as they differentiated either incorrectly to achieve $ax + 3$ where a was usually 1 or made arithmetical slips when substituting $x = 3$ into $\frac{\mathrm{d}y}{\mathrm{d}x} = 2x + 3$. Some tried to find the gradient algebraically using $y - 16 = m(x - 3)$.

Part (b) proved to be a good discriminator. Many candidates often failed to gain any marks. Unfortunately, many candidates who correctly gained full marks in part (a) then went on to substitute $x = 3 + h$ into their $\frac{\mathrm{d}y}{\mathrm{d}x}$ stating the gradient at $PQ = 2h + 9$ thus scoring zero marks in (b) and also in part (c).
However, most recognised that they needed to use $\pm\frac{\mathrm{f}(3+h)-16}{(3+h)-3}$ and most did state gradient of $PQ = 9 + h$, however. those who stated $\frac{16-\mathrm{f}(x+h)}{3-(3+h)}$ tended to make bracket and sign errors. Some candidates were only able to find the y value at point Q and failed to then use the gradient formula to establish the gradient of PQ.

Part (c) was rarely answered successfully. In order to access this mark, they had to have achieved $9+h$ in (b) and 9 in (a). Few candidates referenced the limit as h tends to zero and the most common explanations that gained no credit were: "the answer to part (b) is h greater than the answer to part (a)" or "when $h = 0$ the gradients are same" or "they are linear and parallel."

Question 4

This question provided some difficulty for many candidates although others were able to solve fully in very few steps. The question was based upon a circle with a rectangle along part of a diameter and as such was a bit unusual and this presented difficulty for some candidates. Overall it was quite a good differentiating question as candidates who analysed it and saw the best strategy were rewarded.

Candidates were mostly successful in part (a), although many missed the simplest method of finding $\cos^{-1}\left(\frac{4}{12}\right)$ in radians. A few calculated in degrees and then converted to radians, gaining full marks. Significantly more used inefficient methods, such as finding other angles or sides in triangle ADO, or using Pythagoras and sine or cosine rule, to proceed to the correct solution. It should be noted that many candidates who used the cosine rule with three known sides, which required more steps, were able to complete the work accurately.

Part (b) required finding the area of the composite shape, essentially a major sector of the circle with a right-angled triangle removed. Those failing part (a) could still use the given angle to solve correctly. Many were confused however by the additional removal of triangle *ADO* from the sector area. The positioning of the rectangle on the diagram led some to believe that the area could be calculated by subtracting this rectangle from the circle. Those who failed to gain full marks had usually combined component areas incorrectly. Many assumed that the sector was in fact three-quarters of the circle which it clearly was not. A lot of candidates were able to achieve at least one of the first two method marks for correctly finding the area of a sector or area of the triangle using an allowable angle. There were a lot of responses where the candidates did not achieve the second method mark as they incorrectly applied Pythagoras' Theorem to find the height of the triangle or used an incorrect method to find the triangle area. Those who did not gain the third method mark had mainly used $\pi - 1.231$ or even 1.231 as their angle. The third method mark required a fully correct method to find the required area so those who used an incorrect sector angle were unable to gain the last two marks in (b)

Generally, candidates were more successful in part (c). Almost all used $r\theta$ to find an arc length, but not always the major arc. Many candidates correctly used $\pi + 1.231$ with r = 12 and then added 16 with their $8\sqrt{2}$. Those who attempted to find the circumference of the full circle and subtract an arc before adding tended to be more prone to slips.

Occasionally accuracy marks for (b) and (c) were lost because of rounding the angle to one decimal place before calculations. The question asked for answers to one decimal place but rounding a small angle to 4.4 radians (from 4.373) produced quite a large accuracy error and this should really be known by candidates.

Question 5

Many candidates were usually successful in scoring the majority, if not all, of the marks in this question.

In part (a), most candidates were able to start this question by taking out a factor of x or dividing by 10. The few candidates who divided by x usually scored no marks as the solution $x = 0$ was never found. Most then proceeded to solve the resulting equation either by factorising the resulting quadratic, or by using the quadratic formula. There were few errors in this process. 'Completing the square' was occasionally seen which usually led to an incorrect answer. Candidates should be reminded to read the instructions of the question; the requirement to solve "using algebra" meant that it is recommended to show as many steps as possible. It was apparent that some candidates had used the calculator to find the roots and then work backwards to a factorised form. This approach should be used with caution in questions that require more working to be shown such as this one.

In part (b), many candidates were able to use their answers from (a) to find solutions for y. However, few realised that the solution arising from $x = -\frac{1}{2}$ was not valid, losing the final A mark. Some candidates lost the final two marks because they took the square root of their x value rather than squaring and subtracting 3. A significant number tried to answer (b) without realising that they had to use their solutions from (a). Such approaches were awarded no marks as the question clearly stated 'hence'.

Question 6

This question was one of the most challenging on the paper. There were a substantial number of blank responses. Only the most able were able to gain full marks. It was disappointing to see many candidates not sketching a diagram, those that did generally proceeded to get at least half marks. Centres should stress to candidates that it is good practice to draw a sketch of the problem.

Part (a) was the most successfully answered part with the correct equation of l_2. Most of the candidates who attempted this part reached the equation $y = \frac{3}{4}x - 6$ but failed to write the equation in the form $3x - 4y - 24 = 0$ or $-3x + 4y + 24 = 0$ and lost the A mark. Some candidates struggled with the rearrangement of the equation $3x - 4y - 24 = 0$ correctly.

In part (b), a majority of the candidates could not calculate the area of the paralleogram *PQRS* correctly, but most of them calculated the correct coordinates of the points *P* and *Q*. Many candidates did not appear to know how to find the area of a parallelogram, whilst a significant number thought it was length × width. The most common error in finding the area was multiplying the two sides *PR* and *PQ* or *PQ* and *QR*. A few candidates calculated the lengths of *PQ*, *PR* and the angle RPQ using cosine rule and then used $=2\left(\frac{1}{2}\times PR\times PQ\times \sin RPQ\right)$. Those candidates who split the area into two triangles usually proceeded to score full marks. A very small number of candidates used the shoelace method but nearly none of them reached the correct answer as the coordinates of their S was calculated incorrectly, generally as $S(0,-5)$ or $(0,-6)$.

In part (c) it was very common for candidates to misunderstand the origination and position of the parallelogram. A lot of candidates gained a mark from the SC for $S\left(\frac{44}{3},5\right)$. The most common method was to attempt to equate lengths RS and PQ. Very few candidates used a translation to find the coordinate.

Question 7

This question was well attempted by both medium ability and higher ability candidates. Lower ability candidates struggled to make progress, with most of them scoring no more than one mark. The answers were required in degrees and it was disappointing to see candidates giving all coordinates in radians.

In part (a)(i) many candidates did recognise that only the y value was affected by the transformation of $\sin x$ to $y=3\sin x$. However, there were many candidates who multiplied the x coordinate by 3 instead of the y coordinate and a few gave their answers the wrong way round. In part (ii) many candidates added 90 to 360 giving Q(450,0) or just (360,0).

Part (b) proved the most difficult for candidates to understand. About half of candidates did not gain any marks in this part of the question. Candidates who gained only one mark were generally able to state the x coordinate of R but not the y coordinate. Most common incorrect y coordinates were -7 and -10. Those that did gain full marks did so generally by equating the maximum value of 10 and the equation $y=3\sin x+k$ to achieve $10=3+k$ and then proceed to obtain the y coordinate for R using $4=3\sin x+7$. The most common incorrect answer for this part was $(90,-10)$.

Question 8

Most candidates started correctly by equating the two equations, although a few had an inequality. Some candidates, who did not realise what was required, tried to complete the square to find a minimum or just solved the given quadratic equation. There were many errors in the rearrangement of their equation so quadratics ending with $....11-k=0$ was often seen. Candidates did not always collect the '*x*' coefficients but often continued with the correct '*a*', '*b*' and '*c*'.

Most candidates proceeded to find the discriminant of their resulting quadratic, usually with and used a valid method to obtain 'their' critical values. The majority of candidates continued to find the inside region for 'their' critical values and almost all used the letter *k* when referring to the range of values. A sketch graph proved useful to many in this part.

Question 9

It was pleasing to see a high number of simplifications into the correct two terms at the start of this question. Most candidates correctly attempted to divide by $2x^{\frac{1}{2}}$. A few candidates attempted the quotient (or product) rule, usually correctly. Many candidates found $\frac{dy}{dx}$ correctly, whilst those who did not achieve a correct $\frac{dy}{dx}$ tended to make errors in either the coefficients or the powers of *x*. Some candidates were able to complete the question by finding $x=\frac{\sqrt{3}}{2}$, although some incorrectly gave the negative square root as an answer as well. Many candidates struggled with the final part and many incorrect attempts were seen. Most errors occurred when candidates attempted to factorise $\frac{dy}{dx}=0$. Multiplying by another power of *x* to achieve whole number or positive powers also led to errors and few reached the form $x^{\pm 2}=...$ or $x^{\pm 4}=...$ to gain the method mark. Finding a fourth root also caused problems for some candidates.

Question 10

This was a curve transformation question based upon a cubic presented in factorised form and with a double root. Candidates had to sketch the curve and then correctly analyse a stretch and a translation in x and a translation in y.

Generally, this question was answered well. Part (a) will have been straightforward for those with a graphical calculator, although there were a few candidates who forgot to label x/y-axis intercepts. Most candidates were able to obtain ¾ and 5 as their values on the x-axis. Some who obviously did not have access to graphical technology sketched an incorrect shape, mostly parabolas or negative cubics. A few positioned their curve incorrectly, failing to understand that there would be a repeated root at $x = 5$. In some cases the graph ended at the point $(0, -75)$ losing the last B mark. The last B mark for -75 was generally easier for candidates to obtain, but there were instances where their graph was considerably wrong but it did cross at -75 so, the last B mark was achieved.

On the whole, if a candidate had answered part (a) correctly, they then went on to transform the x-axis intercepts into $\mathrm{f}\left(\frac{1}{4}x\right)$ by multiplying their x intercepts by 4 to give $x = 3$ and $x = 20$ in part (b). There were a few who found the correct values for $\mathrm{f}\left(\frac{1}{4}x\right)$ as 3 and 20, despite having sketched f(x) incorrectly. A common error was to divide by 4 rather than multiplying. Part (ii) required identifying the y-translation so that the original cubic would pass through the origin; when part (a) was correct this was often answered correctly, too.

Part (c) required the x-translation to $\mathrm{g}(x) = \mathrm{f}(x+1)$ and giving the correct expression for g(x). Essentially "x" is replaced by "x+1" in the f(x) expression and some simplification was required. The most common error seen was to simply add a 1 into each bracket. Many struggled to simplify the expression correctly, sometimes with incorrect expansion of the bracket $(4(x+1)-3)$ to $(4x+1-3)$ or by multiplying by -5 instead of subtracting in $((x+1)-5)^2$. Many did not notice that the y-intercept of the new function was the constant found by multiplying the two brackets when $x = 0$. Sometimes a candidate decided to expand the f(x) brackets to obtain the x powers and then change these to powers of (x + 1) but errors were usually made with the coefficients. The question stated clearly that a factorised form for g(x) was acceptable.

Question 11

This proved to be a good question at the end of the paper to discriminate between candidates. It was pleasing to see a good number who scored full marks, and most candidates were able to do something in the question to score a number of the available method marks, even if they made errors along the way.

In part (a) most candidates were able to deduce that the gradient of the normal was $\frac{1}{4}$ from the information given. These candidates then used the correct points to proceed to find the equation of the normal. The occasional error was seen, although some candidates did not attempt this part and just proceeded to part (b).

Part (b) relied on candidates having a good understanding of what information had been presented and determining in which order they needed to use it. Indeed most candidates appreciated that they needed to integrate twice, even if they were unsure as to what else they needed to do. The first hurdle that candidates encountered was omitting the constant of integration or applying a correct method to find the value of the first constant. A significant number used $(4, -50)$ rather than substituting $x = 4$ into their $\mathrm{f}'(x)$ and equating to -4. This may have been due to the order that the information was given. These candidates then either forgot the constant of integration again or did not include it when they integrated for a second time. Some candidates progressed correctly to the end but made a slip with their final constant.

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