Examiners' Report
Principal Examiner Feedback

January 2019

Pearson Edexcel International Advanced Level
In Core Mathematics C12 (WMA01/01)

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The January 2019 C12 paper had an interesting mix of fairly routine questions interspersed with ones that really tested the candidates' ability to think within an examination situation. Unlike earlier examinations of this series, a couple of the early questions, namely question 2 and question 6, had aspects to them that tested even higher performing students. In question 6 on the trapezium rule, the lack of a table seemed to create many more issues than expected. On the whole however, candidates seemed to have been very well prepared for this examination. Many questions were well answered with questions 2, 5, 6, 10, 11, 12, 13, 14 and 16 providing most discrimination. Algebraic notation was good and there were fewer occurrences where candidates had used their calculators to produce answers to questions that required full methods. Timing did not seem to be an issue as there were very few instances where question 16 was left blank.

Question 1: Mean mark 2.7 out of 3

This was a straightforward opening question and the vast majority obtained all 3 marks without difficulty. The few errors came from using $\frac{\delta x}{\delta y}$ for the gradient, or from a sign slip either in calculating the gradient or in processing the line equation. A very small number chose to use a simultaneous equation approach which seemed to be more prone to errors.

Question 2: Mean mark 2.1 out of 4

Many candidates found some difficulty in applying the laws of indices in converting from an 'x' expression to a 'y' expression. Misconceptions about the forms 2^{ab} and 2^{a+b} were common, leading to work such as $2^{2x} = 2(2^x)$ and $2^{x+3} = (2^x)^3$. Parts (a) and (b) were answered much better than part (c).

In part (a) many candidates wrote down y^2 but $2y$, $4y$ and 2^y were all seen. Some candidates rewrote 2^{2x} correctly as $(2^x)^2$ but without changing this to an expression in y.

Similarly in part (b) many candidates wrote down $8y$ but y^3 , $3y$, $y+3$ and $y+8$ were all seen. The intermediate step $2^3.2^x$ was rarely seen, even from those who achieved the correct answer.

In part (c) many candidates did not recognise the need to relate 4 as a power of 2, whilst some others treated the denominator as 2^{4x} divided by 2^4 and then failed to deal correctly with the fractional denominator. This created a sizeable variety of incorrect answers examples, including $2y^{-2} - 3$, $\frac{1}{8^x - 64}$ and 4^{-y+3}. Some candidates left their answers in correct, but un simplified form, which denied them the final A mark.

Question 3: Mean mark 2.9 out of 4

Most candidates found this question quite accessible with many scoring at least three of the four marks available.
The differentiation was generally well executed with, predictably, the differentiation of the $\sqrt{x}$ term being the most common source of errors. A few candidates still had $4\sqrt{2}$ in their dy/dx and others made mistakes by wrongly incorporating $\sqrt{2}$ when differentiating $\sqrt{2}x^2$. Most candidates were able to score the third mark for an attempt to substitute the value $x = 2$ into their dy/dx. The final step of expressing the answer in the form $a\sqrt{2}$ did cause a number of candidates issues. It was a pity to see candidates get as far as $5/\sqrt{2}$ but then fail to make the final step to reach $(5/2)\sqrt{2}$.

Question 4: Mean mark 5.3 out of 6

Candidates frequently scored full marks.

In part (a) the sequence definition was largely understood. Mistakes usually occurred through poor basic algebra such as $4(4k-3)-3=8k-15$ or $4(4k-3)-3=16k-12$ or due to a misunderstanding of the iterative function, so obtaining $u_3 = 4(4k-3)$ or $4(4k)-3$.

In part (b) some attempted to sum an AP with eg $n = 3$, $a = k$ and $d = (4k-3)-k$. Most however were able to sum their three terms, set equal to 18 and solve for k.

Question 5: Mean mark 5.2 out of 7

Most candidates attempted this question with the majority scoring marks in both parts of the question.

In part (a) the most common solution was to see candidates expand as follows:

$$\left(1-\frac{x}{2}\right)^8 = 1+8\times\left(-\frac{x}{2}\right)+\frac{8\times7}{2}\times\left(-\frac{x}{2}\right)^2+\frac{8\times7\times6}{3\times2}\times\left(-\frac{x}{2}\right)^3+$$

Others used the ${}^nC_r$ notation and paired the correct coefficients with the correct powers.
The most common errors were in failing to simplify the coefficients as well as those resulting from the usual bracketing errors. The negative sign also caused problems with $1 + 4x + 7x^2 + 7x^3$ being a common incorrect expansion scoring 2 of the 4 available marks. Candidates who expanded to five terms were still able to score full marks.

Quite a number of candidates did not attempt part (b). For those that did the most common solution was to see candidates attempt to solve $\left(1-\frac{x}{2}\right) = 0.9$ to reach $x = 0.2$, before substituting this into their expanded form. However some candidates found $x = 0.2$ and failed to proceed any further, whilst others thought that x was 0.1 or even -0.2.

Question 6: Mean mark 2.9 out of 7

The awarding of full marks in this question was quite rare. In general the sketches were of a poor quality and mistakes made with the trapezium rule, especially concerning the number of strips used, were disappointingly common.

In part (a) many candidates failed to show the coordinates of both the points of intersection while a significant number had straight lines giving a V shape or non-symmetrical graphs. Some used degrees and thus lost the mark for the coordinates of the points where the curve met the x-axis.

In part (b) a very common error was to omit the value of y corresponding to either $x = 0$ or $x = 2\pi$ and thus proceed to $(\pi/6)\ \{1.5 + 2 + 2\ (\ ½ + 0 + ½ + 3/2\ )\ \}$ leading to an answer of $17\pi/12$.

Another common wrong approach had a strip width of $2\pi/5$ thanks to using only 6 values of x between 0 and 2π. It was also not uncommon to see incorrect decimal values of y acquired from a calculator.

However some very good responses were seen and this was evidence of a very good student.

Question 7: Mean mark 3.6 out of 5

Most candidates realised that they had to consider the discriminant. A surprising number wrote down $5p^2$ instead of $(5p)^2$ or $25p^2$ in their expression for $b^2 - 4ac$, although method marks were still available for those candidates. A disappointing number began by cancelling p in their two term quadratic, especially those who "separated" the two terms, eg $25p^2 < 8p$. These candidates invariably obtained only one solution, and so were unable to score the last two marks. In fact 3 out of 5 was a very common mark, usually from candidates who found two values of p but did not choose the "inside region".

Question 8: Mean mark 4.0 out of 5

As in all questions where there is a printed result, it is important for students to appreciate that showing intermediate steps is essential.

The majority of candidates carried out the integration successfully, especially when $\dfrac{6}{x^2}$ was written in index form first. A common error was to write their integrated term $\dfrac{6}{k}$ as $6k$ or else integrating the $10k$ term on the rhs of the equation thereby losing the final three marks. The most common error was the usual bracketing one, and many candidates ended up with -11 instead of -7. A pleasing number multiplied through by k obtaining the correct answer in the required form. A few otherwise good solutions lost the final mark by failing to complete their final statement with '= 0'.

Question 9: Mean mark 5.8 out of 8

Parts (a) & (b) were often answered correctly. Occasional slips in the sign for one or both centre coordinates, or the use of 10 and 6 instead of 5 and 3 were seen. In some of these cases, the squares $(x+5)^2 + (y-3)^2$ … were correctly obtained but then wrongly interpreted. Occasional errors in calculating the radius included $r = 25$ instead of $r = 5$ or a sign error such as $r = \sqrt{(5^2 - 3^2 - 9)} =$

Common errors in part (c) were to use the gradient of the radius (4/3) instead of the gradient of the tangent or to make a sign error leading to an incorrect gradient of the perpendicular, eg $\frac{7-3}{-2-5} = -\frac{4}{7}$ In all these cases, a quick diagram would have helped immensely!

Question 10: Mean mark 7.4 out of 11

This was well attempted by many, but a sizeable minority clearly were not comfortable with radians and expended energy and time converting to degrees, not always with success.

In part (a) the sine rule was used appropriately by the majority of candidates. Errors arose when some gave the answer to 2sf (0.35) instead of 3sf (0.351). A large number surprisingly gave the value of angle *DAO* as 0.344, failing to use arcsin.

In part (b) the most common method was to use the cosine rule, but the sine rule was also regularly seen. This was a show that question and the required intermediate step between an equation for AO or AO^2 and the answer 4.9 was sometimes missing. Occasional errors were seen in attempting to find angle *ADO* using the other two angles in the triangle

In parts (c) and (d) the most likely cause of error was in calculating the sector area or the arc length, with the angle for the major sector sometimes given as $\pi - 0.84$ instead of $2\pi - 0.84$. Many incorrect formulae for sector area were seen, such as $r^2\theta$, $r\theta^2$ and even $\pi r^2\theta$. Many calculated the area/circumference of the whole circle and the area/arc of the minor segment. Whilst most proceeded correctly from this point a surprising number then added/subtracted overlapping areas or included extra arcs and sides.

Question 11: Mean mark 5.5 out of 8

Part (i) caused a great many problems and very few candidates achieved all 3 marks. A small number made no progress believing that the answer was $\log_4 324$ but many scored at least 2 marks by reaching $x = 324^{1/4}$ or $x = \sqrt[4]{324}$ or $x = 4.24$.

Part (ii) was more familiar with most candidates able to use the subtraction law of logs. Many could then manipulate their equation to remove the log correctly and so obtain a correct equation. Poor manipulation, or misreading of the question, meant the loss of the final 2 marks.

The errors seen from students who achieved $a^3 = \dfrac{5y-4}{2y}$ were

- writing a final answer as $a = \sqrt[3]{\dfrac{5y-4}{2y}}$ or $y = \dfrac{5y-4}{2a^3}$
- incorrectly dividing to form $a^3 = \dfrac{5}{2} - 2y$ before rearranging
-

Question 12: Mean mark 6.1 out of 9

On the whole parts (b) and (c) of this question were done far more successfully than part (a). Unusually for a question like this, both AP and GP formulae were required, and there were instances where candidates just used one of the two sets of formulae an attempt to solve all three parts.

In part (a), the most common and costly mistake was to use the term instead of the sum formula. For these candidates only one of the four marks could be scored - for correctly solving an exponential equation by the use of logs. However most candidates did attempt the use of the correct geometric sum formula but poor manipulation sometimes resulted in failure to reach the correct equation $1.1^N = 5$. A small number of candidates proceeded to a statement of $N = 17$ but with little or no working shown. Candidates do need to heed the requirement that sufficient working must be shown to make methods clear and that failure to do so may result in the loss of marks.

Part (b) was particularly well done and with almost all candidates gaining both marks.

Similarly in part (c) a high proportion of candidates were completely successful. Candidates who found the total number of people before multiplying by 5 were most successful. Common mistakes for those who attempted one sum formula were to mix up how to apply the "£5" to the question with errors on the values of "a" and "d".

Question 13: Mean mark 6.73 out of 10

Overall, this question was answered well with part (c) being the least successful, whilst parts(a) and (b) almost always scored full marks.

In part (a) almost all candidates substituted $x = -3$ into the expression for f(x) and equated this to zero in order to evaluate c. This was a 'show that' question so sufficient steps had to be seen in order to gain both marks.

In part (b) almost all candidates were successful in finding Q(x). Some candidates used factorisation while others used long division.

In part (c) many candidates knew that they were required to consider the roots of Q(x). Most candidates, who attempted this part of the question, either found the discriminant or attempted to solve Q(x) using the quadratic formula. Having found that the discriminant was -12, some just said 'negative' or 'doesn't factorise', with no more working. Many candidates scored A0 as they gave no clear explanation as to why there was only one real root. As well as candidates having to say that Q(x) has no roots they additionally needed to comment that therefore (x-3) would give the only root.

For (d) (i) many candidates drew a positive cubic graph in the correct position and gained full marks. The most common error was to shift one of the turning points to be on the y-axis. Another common error was to state the x -axis intercept as $(-3,0)$ or $(-9,0)$ rather than $(-1,0)$.

For (d) (ii) most candidates drew a negative cubic graph in the correct position. The most common error was, again, to shift one of the turning points to be actually on the y- axis or omit the y intercept.

Question 14: Mean mark 7.2 out of 11

There were some excellent responses to this question on trigonometry but very few candidates gained full marks.

Candidates seemed to find part (i) difficult, possibly on account of the negative value. Those who adopted a methodical approach were more successful but many who obtained (x+60) = -23.6 then changed to + 23.6 and proceeded to find a list of incorrect answers. Those who drew a CAST diagram or graph had more success but again often ignored the negative values, perhaps forgetting that they were finding solutions in the range $-180 < x < 180$.

The majority of candidates knew how to approach part (ii)(a) of the question and used correct identities. Many lost marks however through carelessness and poor notation. Candidates should be aware that where the answer is given, they need to set out their work clearly and include sufficient steps to show each part of the process. For (ii)(b) most candidates were able to solve the quadratic equation and obtain a correct value for $\cos\theta$. Marks were lost due to rounding off the decimal value 0.4574 to 0.46 thereby losing the accuracy when finding values for θ.

Question 15: Mean mark 7.9 out of 11

Part (a) was very well done. Nearly all students knew how to equate the two expressions for y and process the 3TQ successfully scoring the first five marks. Values for x were obtained through factorisation or use of the quadratic formula. Some wrote down the answers from their calculators and providing they had obtained a 3TQ were able to score the marks. A few forgot to find the y coordinates thereby losing the last two marks.

For part (b) the most successful method was integrating the curve between $x = 0$ and $x = \frac{1}{4}$ and then finding the complementary area of the triangle between $x = \frac{1}{4}$ and $x = \frac{5}{3}$. There were many short, elegant, completely correct solutions using this approach. Many used integration to find the area of this triangle which was fine.

A variety of other methods were used, with most losing the last three or four marks. The most popular incorrect method involved finding the area between the curve and the line between the two points on intersection.

Question 16: Mean mark 7.9 out of 16

There were lots of concise and well written solutions to question 16. As usual there were many candidates who ignored part (a) and attempted just parts (b) and (c).

For part (a) there were two key pieces of information given in the question. The container was open at the top but a sizeable minority attempted to add an extra "$5xl$" term onto the expression for their area. The volume was given as 0.75 m^3 and there seemed to be much confusion as to whether the volume was $4x \times 3x \times l$ or half that amount. Errors usually resulted from one of those two facts although poor algebra was evident at times.

In part (b) the differentiation was generally well done. Most put S' =0 and were able to proceed to a value for x although errors surrounding the "8" on the denominator were common. Other errors included differentiating again and then putting $S'' = 0$ or incorrect processing of the negative power leaving either the potential for a negative x or arriving at the disallowed n=1.

In part (c) most candidates correctly attempted to find the value of S'' at their x=0.332 but many lacked both the reason and conclusion required for the A mark. Surprisingly many candidates just found the value of S here.

In (d)(i) those candidates who had found a value for x in (b) were often able to apply Pythagoras' theorem picking up the M mark. Sadly some only squared the "0.332" part. A more elegant solution was to find $5\times$"0.332". In (d)(ii) those who had attempted part (a) had an expression for l that they could use to solve the problem. Candidates who hadn't attempted part (a) usually left this blank.

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