Examiners' Report

Principal Examiner Feedback

January2020

Pearson Edexcel International GCE In

Core Mathematics C34 (WMA02) Paper 01

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

Grade Boundaries

Grade boundaries for all papers can be found on the website at:
https://qualifications.pearson.com/en/support/support-topics/results-certification/grade-boundaries.html

January 2020
Publications Code WMA02_01_2001_ER

General

This paper proved to be a good test of students' ability on the WMA02 content and plenty of opportunity was provided for them to demonstrate what they had learnt. There was no evidence that students were pressed for time. Examiners reported that they saw some very good work but also that there were some instances of copying errors. Marks were available to students of all abilities and the questions that proved to be the most challenging were 3, 4c, 13 and 14.

Report on Individual Questions

Question 1

In part (a) the majority of candidates differentiated f(x), set it equal to zero and rearranged correctly. However, a significant number of candidates tried to divide the terms of the quartic by x to reach the printed answer. These candidates presumably did not realise that a turning point was required. There were a few candidates who accidentally wrote a square root sign rather than a cube root sign for the final answer. It was very rare for a candidate to omit the required step of making $8x^3$ or x^3 the subject first. The alternative solution was rarely seen and those candidates who attempted to work from the printed answer were usually unsuccessful as they were still unable to appreciate that the printed answer came from the derivative of f(x). Occasionally a candidate left the answer in terms of a and this lost the final mark.

Part (b) was the most successful part of question 1. Almost all candidates appreciated that they were required to substitute 0.6 into the iterative formula and gave the result to four decimal places as instructed. Some candidates lost the accuracy mark by rounding to a lesser number of decimal places or truncating their answers too soon.

In part (c), the majority of candidates substituted suitable values into the derivative of f(x) and made an appropriate conclusion following values of different signs. However, a significant number of candidates substituted values into f(x) and despite two positive values wrote out the expected conclusion "sign change therefore root". Other candidates incorrectly changed the sign of one of the values of f(x) or crossed one of the values out before giving the standard conclusion. A few candidates substituted into f(x) and concluded that as the results were the same, there must be a root. It was not uncommon to see repeated iteration which gained no credit. Overall, there were very few slips with signs or arithmetic.

Question 2

This was a standard question but there were a significant proportion of candidates who did not achieve full marks.

In part (a), the majority attempted to take out $\sqrt{\frac{1}{4}}$ as a factor but were not always able to process this correctly. Most used the correct structure for the binomial expansion and usually achieved the correct result if they used $-12x$ as required, with only a few sign or arithmetic errors. The majority gained full marks using this method. A common incorrect x term used was $-\frac{3}{4}x$. Some candidates attempted an expansion of $(a + b)^n$ directly. Some of these were successful but many made errors, often using non-standard notation such as ½C*r* which did not gain the method mark.

In part (b), the majority candidates substituted the correct value of x into their expansion but then a common error was failing to multiply by 10. A few, having substituted 0.01 into $(\frac{1}{4} - 3x)^{\frac{1}{2}}$ and achieved 11/50 then put this value into their expansion. Many failed to give their answers to the correct accuracy and lost the final mark in this part. Some truncated their answer to 4.6904 having previously written 4.69046 perhaps having been influenced by the actual value of $\sqrt{22}$.

Question 3

The vast majority of students knew how to use the Trapezium Rule, but only a small minority could apply their answer in (a) to part (b).
Part (a) was generally well done by candidates. If they recognised the need to use the five ordinates from $x = 4$ to $x = 6$, the y values were almost always correct. Some errors included using y_0 to y_2, using 5 strips, not recognising the end points of $x = 4$ and $x = 6$, or using three or four ordinates. Some candidates made rounding errors, particularly for 2.89897… and 2.98935… but these did not usually impact on them getting to the correct answer.
In part (b) the most common mistake, for both parts, was attempting the trapezium rule again. Some even tried integration. The majority of candidates did not use their answer to part (a) despite being instructed to do so in the question. In (i) a few candidates picked up on the need to multiply by 6, but sometimes tried to divide by $\sqrt{2}$ rather than 2. Part (ii) was the least successfully answered part and a common error from those who tried to use (a) was to multiply their answer from (a) by 1.3, rather than just adding 6.

Question 4

Parts (a) and (b) of this question were generally well attempted, with many candidates achieving full marks, but it was rare to see a solution gaining any marks in part (c).

In part (a) almost all candidates sketched a V-shaped graph and many showed the correct intersection with the y-axis, with the most common error being in dealing with the +1, resulting in intercepts of 6 or 7. There were more mistakes in finding the coordinates of the minimum point, with the most common error for it to be on the x-axis.

Part (b) was generally well attempted with the majority of candidates gaining full marks. The most common error was again dealing incorrectly with the +1, or switching the signs of the $14 - x$ rather than the $2x - 7$. Very few candidates attempted the method of squaring both sides, and most of those who did, failed to obtain the correct solutions.

Many did not attempt part (c). Of those who did, most candidates did not spot the most obvious method of using the intersection of the line and the coordinates of the minimum point to find k. Many attempted to solve $\frac{1}{2}x + 7k = |2x - 7| + 1$. Although it is possible from this to get two equations for x in terms of k, then eliminate x to get $k = -\frac{3}{4}$, few candidates progressed very far with this approach.

Question 5

Many candidates found this question difficult and fully correct answers were rare.

Part (a) was answered well by most candidates using the correct notation. One common mistake was using a $<$ sign rather than a $\leq$ sign. Some got the 27 correctly, but incorrectly gave the range as $0 \leq f(x) \leq 27$.

In (b) (i), this mark was usually gained by the candidates, recognising the need to solve $9 + 3x = 0$, although a surprising minority left their answer as $\frac{-9}{3}$. The most common mistake made was to put $9 + 3x = 12$ and solve.

In (b) (ii), the majority of candidates gained the first M1 by using $f(12) = 0$ and reaching $B - 144A = 0$ in various forms. Fewer candidates recognised that substituting $x = 6$ into '$B - Ax^2$' equalled 27, and therefore lost the next two marks. Those who did use both equations generally gained the final mark.

Only a minority of candidates answered part (c) correctly, with most candidates incorrectly using the first expression for $f(x)$ twice, scoring no marks. Almost all found $f(0) = 9$ correctly, but failed to recognise that their new 'x' was greater than 6, and therefore needed use of the second expression '$B - Ax^2$'.

Question 6

Many candidates achieved full marks on this straightforward question testing integration by the separation of variables and integration by parts involving a ln$x$ term.
Following separation, a generous mark was available for finding $\int y\,\mathrm{d}y = \frac{y^2}{2}$ (+ c) and two further marks were available for finding $\int 4x\ln x\,\mathrm{d}x$ by parts. Candidates who took "4x" as the term to integrate were more successful than those who took 4 out as a factor initially and integrated x. A few candidates who had separated the variables struggled to integrate the product 4$x$ln$x$, putting their u's and v's in the wrong places. Substitution to find the constant of integration was mostly successful and then substituting e for x followed.
A few candidates lost the final mark by failing to combine the terms in e^2 or by adding the ± symbol to the square root sign despite being told that $y > 0$. A significant number of candidates did not include a constant of integration and were unable to earn any of the final three marks. A small number of candidates integrated y with respect to y but then differentiated 4$x$ln$x$. These candidates were able to earn the method mark for substituting to find the constant of integration but not the final method mark which depended upon both earlier method marks having been earned. A significant number of candidates made numerical errors when finding the constant of integration or did not double it when making y^2 the subject. A significant number of candidates separated the variables incorrectly to obtain $\int \frac{1}{y}\,\mathrm{d}y$. Some candidates did not take care with the correct notation and were missing integral signs or dx and dy but usually their subsequent work implied these omissions. There were quite a few candidates who did not attempt this question.

Question 7

In part (a) the product rule was rarely quoted but was usually correctly applied. Missing the 2 from the derivative of the bracket was the most common error and several benefited from the first A1 being awarded for an unsimplified form. Factorising to the required form was usually achieved but sometimes it seemed that this was only because the required form was partially given. Those who factored out the 15 early, and worked with 'fifths', made their attempt more difficult. A small number of candidates did not make any attempt at factorising.

In part (b), while most candidates were able to correctly obtain the critical values, a much smaller proportion then went on to find the correct range with them. Many would incorrectly write $x < \frac{1}{2}, x < \frac{5}{2}$. For those who had not obtained the correct expression in part (a), and therefore could not find both correct critical values, most were able to write down the correct inequality for the upper end of the range $x < \frac{5}{2}$ and therefore overall, the majority of candidates managed to gain one of the available marks.

Question 8

Many candidates gained full marks on this question with Way 1 being by far the most common approach. Most attempted a correct integral, and most who then recognised that the double angle formula for sin $2t$ was needed, used it correctly. A few tried to use integration by parts on sin $2t$ cos t however, and made no progress. Very few candidates needed to use substitution, recognising this was a direct integration with the only error being a slip in the sign. The correct limits of $\frac{\pi}{6}$ and 0 were used in almost every case to reach the required result. Those candidates who used substitution usually chose u = cos t and were mostly successful, again with just an error with the sign. The correct limits of $\frac{\sqrt{3}}{2}$ and 1 were usually applied to achieve the required result.
Common errors were:

- integrating y^2 rather than y (volume of revolution formula)
- differentiating rather than integrating
- using incorrect limits most commonly $\frac{\pi}{2}$ and 0, or 2 and 0
- having reached $\int 24\sin t\cos^2 t\ \mathrm{d}t$ replacing $\cos^2 t$ by $1 - \sin^2 t$ or ½(1 + cos $2t$)

Way 2 on the mark scheme was the least seen method which was unsurprising as it is not in the specification. Those candidates who used this approach were usually successful.

Way 3 on the mark scheme was the least successful approach with the few candidates who attempted it, struggling to integrate from the form $\int \left(\frac{9}{4}x^2 - \frac{9}{64}x^4\right)^{\frac{1}{2}} \mathrm{d}x$.
The few candidates who were successful, chose to substitute using for example $u = 16 - x^2$ and the limits 12 and 16.

Question 9

Most candidates managed to substitute the given value of λ in order to get the required point, but went on to incorrectly calculate the values from that substitution. The most common error was from simplifying 4 – 2(-2). The first M1 was gained by the majority of students as they correctly identified the need to utilise the x and z components in order to find 'μ' and then 'a'. Frequent algebraic and sign errors led to incorrect values of 'a' in a surprising number of cases. A lower proportion of candidates realised that the scalar product of the two direction vectors was necessary to progress in the question, with a minority of these mistakenly using incorrect vectors. Those who used the correct vectors generally went on to find both 'b' and 'c' from the y component.

Question 10

Most candidates made a good attempt at this question but a minority gained full marks with most marks lost for lack of accuracy and omitting negative roots.

In part (a) the vast majority of candidates realised that they needed to use implicit differentiation. Most gained full marks, but some had sign slips or mistakes in the product differentiation. Candidates generally gained the mark for factorising, where available, despite earlier errors.

In part (b) almost all who achieved an algebraic fraction result in (a) went on to put the numerator equal to zero and most proceeded to find y as a function of x or x as a function of y. Only a few had an incorrect numerator in terms of x only or y only so were unable to score any marks in this part. Substituting to find an equation in one variable and solving this sometimes led to algebraic or numerical errors but the majority managed to find a correct value for one variable, although the negative root was often omitted. An unsimplified version of the second variable usually followed. Candidates who used the initial $y = \mathrm{f}(x)$ or $x = \mathrm{f}(y)$ were generally successful in gaining this mark, however candidates who substituted into the equation for C often did not reach a final answer for the remaining variable. The final mark was rarely gained, either due to missing the negative pair of coordinates or because coordinates were in an unacceptable form, either not exact or not fully simplified. A few candidates produced fully correct solutions to the question but went on to pair them incorrectly, losing the final accuracy mark.

Question 11

Many candidates struggled with part (a) but most obtained the majority of the available marks in part (b). In part (a) there were many different approaches seen. Very few used the simplest approach of adding the given fractions and noticing that their numerator was $\cos(3\theta - \theta)$. Invariably those who did, scored full marks very quickly. Most candidates expanded $\sin(2\theta + \theta)$ and $\cos(2\theta + \theta)$ and often found the algebra difficult and lost marks because of a mistake with a sign or incorrectly adding terms, so failing to get $\cos 2\theta$ as a factor. A few using this method did not add their fractions but noticed that their expression was now $\frac{1}{2}\cos 2\theta\,(\tan\theta + \cot\theta)$. These candidates still had some work to do to complete the proof. A small number attempted to use the factor formulae, which was quite a quick method. A few used the formulae for $\cos 3\theta$ and $\sin 3\theta$ (sometimes quoted, sometimes derived), and these attempts were often correct.

Part (b) was frequently answered well, but many candidates missed $\frac{\pi}{4}$ as a solution, usually because they divided by $\cos 2x$ instead of factorising. A few candidates failed to link to part (a) and wrote down an incorrect expression for $\cot 2x$ or having written down the correct expression could not rearrange correctly. Some rounded their values of $2x$ too much, and then divided by 2 to incorrectly get either 0.100 or 1.471. A minority incorrectly worked in degrees.

Question 12

This question was generally well attempted, with most candidates gaining at least 3 marks. The vast majority attempted to factorise the denominator and find partial fractions. However, those who did not realise that they needed to deal with the improper fraction were only able to gain 3 of the marks. Some split the numerator at the start which, if done correctly, did lead to a correct answer. A few factorised $x^2 - 4x$ incorrectly, which again significantly reduced the marks available to them. The integration and substitution of limits were generally completed correctly, but many did not use a modulus for the logs and then were unable to deal with the resulting logs of negative numbers, often omitting them altogether. A significant number of candidates lost marks because they did not combine the log terms in their final answer. There were a number of attempts using integration by parts, but invariably once they had their u's and v's and put them into the formula they were unable to make any further progress.

Question 13

The majority had seen this type of question often enough to make a good attempt, though many of these found the algebra in (c) a problem. In (a) those who used the quotient rule to find $\frac{\mathrm{d}y}{\mathrm{d}t}$ tended to do so correctly. Some lost the first two marks by using $u\frac{\mathrm{d}v}{\mathrm{d}t} - v\frac{\mathrm{d}u}{\mathrm{d}t}$.
The few who used the product rule were often not able to simplify their derivative as required. Most candidates attempted $\frac{\mathrm{d}y}{\mathrm{d}x}$ correctly.

Part (b) was generally well answered, most gaining at least three of the four marks, even with errors in (a).

In part (c), Many substituted the parametric expressions for x and y into their tangent equation, but even if they had the correct equation in (b) only a few processed correctly to get the correct cubic equation in t. Those who did, usually scored full marks. Those who did not get (b) correct often did not recognise that they needed to use the fact that they already knew one root of the cubic ($t = 2$) and so could factorise or divide by ($t - 2$) to get the other root, and hence the required point. A minority chose to get t in terms of y, and substitute into both the parametric coordinate of x and then into their tangent equation to get a cubic equation in y. This proved to be a more complicated version, but there were a few correct solutions seen.

Question 14

Many candidates were successful on this question with the vast majority scoring 8 or more of the possible 11 marks. It was extremely rare for a candidate to make no attempt at this question.

In part (a) the vast majority of candidates were successful in substituting $t = 0$ and proceeding to a value of 360. A few candidates incorrectly gave the initial number of lizards as 900.

In part (b) the vast majority of candidates successfully deduced that as t tended to infinity, then N tended to 1800/2 = 900. A few candidates gave 360, 1800 or infinity for the upper limit.

In part (c) the majority of candidates were able to substitute $N = 780$ and proceed correctly to a simplified version of the equation and then successfully apply logarithms correctly to reach the correct solution. A few candidates gave the exact form despite being asked for an answer rounded to 1 decimal place. Candidates who were not successful tended to struggle with taking natural logs of the term $3e^{-0.2t}$. Candidates who gave an incorrect value for t without showing all steps, lost both the dM1 and the second A1 mark.

For part (d)(i), the majority of candidates who attempted this usually scored the first 2 marks without too much difficulty. The most common approach was to use the quotient rule but those candidates who chose to use the product rule or chain rule were equally successful.
A small number of candidates made an error with the sign of the numerator and a few failed to square the denominator (even after correctly quoting the quotient rule). A few had an extra term in the numerator because they did not have $u' = 0$. It was rare for candidates to differentiate $e^{-0.2t}$ incorrectly to $-0.2\, t\, e^{-0.2t}$. Candidates who attempted to substitute all the terms in $e^{-0.2t}$ with expressions in N usually gained the dM1 mark, even though they may have been unsuccessful in reaching the required form. The majority of candidates used the direct approach rather than Way 2 but some made the algebraic process very complicated. Those who manipulated the expression for N separately to find expressions for $2 + 3e^{-0.2t}$ and $e^{-0.2t}$ were more likely to reach $A = 4500$ than those who expanded the denominator before making any substitutions. A few candidates were able to substitute for $2 + 3e^{-0.2t}$ in the denominator but did not replace the $e^{-0.2t}$ in the numerator and abandoned the question at this stage.
In (d)(ii) it was very rare for a candidate to realise what was being asked for in this part of the question with the vast majority of candidates stating 900 and/or 0 as the answer as they were clearly considering $\frac{dN}{dt} = 0$ and not $\frac{d^2N}{dt^2} = 0$. Successful candidates found the second derivative and set it equal to zero and solved for N, or more simply considered the symmetry of the roots of $\frac{dN}{dt} = 0$ and deduced that the required value for N was midway between 0 and 900.

Pearson Education Limited. Registered company number 872828
with its registered office at 80 Strand, London, WC2R 0RL, United Kingdom