Examiners' Report

Principal Examiner Feedback

October 2020

Pearson Edexcel International A Level

In Pure Mathematics 4 (WMA14)

Paper: 01 Pure Mathematics 4

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

October 2020
Publications Code WMA14_01_2010_ER

General

This was the first WMA14 paper of the new IAL specifications. Candidates were generally well prepared for the examination with very few blank responses to questions. Questions that did cause some difficulty were question 1 on proof by contradiction and question 6 on implicit differentiation.

Question 1

There were very few completely correct solutions here. The main causes of this were;

- failing to set the contradiction up correctly, either by not including this step, or by mixing up the requirements e.g. m is even when m^3 is odd
- trying to prove the statement using number values only e.g. 2,4, 6....or by using expressions such as 'n+1' for their odd number or trying to show it was true with '2n'
- using a logical proof rather than an algebraic proof, e.g. stating that odd×odd×odd=odd.

Those candidates who selected the correct method of using the expression $2m+1$ or $2m-1$ for an odd number almost all were successful at expanding the brackets in $(2m\pm1)^3$. The next step was also well handled for those getting this far, with the resulting expression re-arranged to demonstrate it was one more than a multiple of 2, therefore odd. The vast majority were then able to include a suitable conclusion to complete the proof.

Question 2

Most candidates completed part (a) correctly. The biggest errors were failing to correctly take out the common factor of 4 or forgetting to multiply by $4^{-\frac{1}{2}}$ at the end, particularly in the final term.

In parts (b) and (c), nearly all candidates recognised the need to replace the second bracket with their expansion and went on to expand the brackets. Candidates who got part (a) correct, generally went on to get parts (b) and (c) correct. The most common error was missing one of the coefficients when making the comparison, particularly in part (c), where some candidates missed their $\frac{75}{256}\times2$.

Question 3

Most candidates were able to find the upper limit as $2\ln 2$ or $\ln 4$ as required. The majority of candidates then knew that they had to square the expression before integrating and most managed to integrate one of the exponential terms correctly to gain the first method mark. Candidates were confident in applying limits correctly throughout the paper including this question and many candidates went on to find the correct answer.

Errors regularly seen were

- slips in squaring $\left(e^{0.5x}-2\right)$ with omissions of the middle term and also $\left(e^{0.5x}\right)^2=e^{0.25x^2}$
- the omission of π in the solution even in cases where $\pi\int y^2\,dx$ was quoted

Question 4

This question was a very useful source of marks to candidates.

In part (a) candidates mostly knew how to find the coordinates for A and B. The majority found $t = \pm 2$ but marks were lost by those who made errors in the algebra leading to the coordinates for A and more frequently those who failed to show that the coordinates of B were $(20, 0)$. It is vitally important that all steps are shown when the answer is given.

Part (b) was very well answered, with most candidates scoring full marks.

In part (c), most knew that they were required to combine the given answer in part (b) with the parametric equations. Proceeding to, and solving the ensuing cubic, were efficiently processed by high ability candidates. It is important to note that the question required the use of algebra and, although calculator solutions were accepted, some clearly shown method was necessary. Reasons for a loss of marks in part (c) were

- incorrect algebra leading to an incorrect cubic equation in t
- finding $t = \frac{20}{7}$ and then stopping
- not showing sufficient algebra or incorrectly stating that $7t^3 + 8t^2 - 52t - 80 = (t+2)(7t-20)$ or even $7t^3 + 8t^2 - 52t - 80 = (t+2)\left(t - \frac{20}{7}\right)$

Question 5

In part (a), most candidates realised they should be using integration by parts to tackle the question and most were successful in gaining the first method mark and usually the second mark as well. There were occasional sign errors when integrating, leading to candidates losing the accuracy mark. There were a few who failed to simplify $\int x^{-1} \times \frac{1}{x}\,dx$ leading to errors with the powers and therefore leading to an incorrect integral. As is usual a few candidates used the parts formula the wrong way around, differentiating the x^{-2}, and thus failing to make any progress.

In part (b), most realised they would need to write $\frac{3 + 2x + \ln x}{x^2}$ as $3x^{-2} + 2x^{-1} + x^{-2}\ln x$ in order to integrate the expression. The integration that followed was usually successful using their answer to part (a). There were occasional errors on the integration of $2x^{-1}$ term which usually involved ending up with αx^{-2} term rather than a $\ln x$ term. Some that didn't simplify the $\frac{2x}{x^2}$ were still able to score the marks here for integrating to $\ln\left(x^2\right)$. The majority then attempted to substitute 2 and 4 into the expression but earlier errors meant the second method mark wasn't possible as they didn't have an expression in the required form. There were a few attempts to (b) that started the question from scratch using integration by parts again but not many of these were successful.

Question 6

This proved to be a very discriminating question with prepared candidates scoring the majority of marks but others achieving one mark or less.

In part (a), the vast majority of candidates were able to use the hint given in the question, taking natural logs of both sides to achieve $\ln y = \sin x \ln x$. This proved to be as far as some candidates could progress, being unable to differentiate either side. The RHS caused more problems in general, with plenty of candidates arriving at $\frac{1}{y}\frac{\mathrm{d}y}{\mathrm{d}x} = \ldots$ For those that were able to proceed, the majority successful managed the product rule on $\sin x \ln x$, multiplying by y to achieve a correct answer.

In part (b), those with correct solutions from part (a) generally knew to set their expression equal to zero and were able to simplify by dividing by y. A minority of candidates however lost the final mark by failing to show that they needed to divide by $\cos x$ to achieve the equation in $\tan x$. This again was a given answer and it should be impressed on candidates the need to show all stages of the proof.

Question 7

This question on integration also proved to be very discriminating.

In part (i), the majority of candidates chose one the of the substitutions given in the main mark scheme and so there were no great barriers to starting the question. They were then able to change all aspects of the integral including the $\mathrm{d}x$ and the limits. Many candidates achieved the correct answer of 16 and for those who did not, it usually was down to a simple numerical slip. Occasionally candidates attempted alternative substitutions, including $u = 2x$ and various trigonometric substitutions, to varying degrees of success. The most common mistake was a failure to substitute correctly for $\mathrm{d}x$, with some simply swapping it for $\mathrm{d}u$, others substituting incorrectly (e.g. using $2\mathrm{d}u$), and others neglecting it completely. For those candidates choosing a valid substitution, almost all were successful at splitting the integrand into two fractions, simplifying and integrating, although there were some incorrect coefficients.

As given in the mark scheme a minority of candidates ignored the instruction and integrated by parts with varying success, but they were limited to a maximum of four marks having not satisfied the demands of the question.

In part (ii), candidates overwhelmingly recognised the need for partial fractions, but the most common error by far was a failure to realise that the integrand was an improper fraction, which needed long division. As such, these candidates were able to score a maximum of two marks if their integration was otherwise correct. Of those who attempted long division, most of gained the correct values of A, B and C and were able to get the form of the answer. Common errors at this stage were integrating $\frac{1}{2x-3}$ to $\ln(2x-3)$ or omitting the constant of integration in their final answer, losing the final accuracy mark as a result.

Question 8

In general, the response to the part (a) of this question was much improved on previous similar questions. Almost all candidates were able to use the vector line equations to create simultaneous equations in λ and μ, with occasional slips in copying down an equation or in solving the simultaneous equations. For the majority this led to correct values which they were able to substitute correctly to find the correct column vector. Some candidates lost marks through incorrect notation, giving vector answers instead of coordinates (and vice versa in part (b)).

Part (b) was not as well attempted. For many candidates this part was their least successful question with frequent blank responses or attempts which showed little understanding. Those candidates who knew the correct approach to take were generally successful, although a large number ended up giving Q as a vector rather than coordinates, losing the final accuracy mark. There were occasional errors in finding the value of μ, due either to miscopying one of the vectors or whilst expanding the brackets in their dot product. Most candidates substituted their value into the correct vector expression and gained the final method mark despite previous errors. There were a few candidates who used the scalar product with something other than $\begin{pmatrix} 2 \\ -1 \\ -3 \end{pmatrix}$.

Question 9

In part (a), the majority of candidates knew that they needed to separate the variables, use integration and the given conditions before arriving at an equation for A. Completely correct solutions were rare however, even in cases where the algebra was sound. Common causes for loss of marks were;

- an incorrect position for the '5' with many integrating $5t^{-2}$ rather than $\frac{1}{5}t^{-2}$
- failing to deal with the reciprocal of $A^{\frac{3}{2}}$ and using a negative power
- weak algebraic skills when moving from $\frac{p}{\sqrt{A}} = \frac{q}{t} + r$ to $A = \left(\frac{pt}{qt + r}\right)^2$

Part (b) was also very demanding and was frequently omitted. The idea was that as $t \to \infty, A \to \left(\frac{a}{b}\right)^2$ but various methods were seen including differentiation.

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