Pearson Edexcel

Examiners' Report

Principal Examiner Feedback

October 2020

Pearson Edexcel International A Level

In Pure Mathematics 2 (WMA12)

Paper : 01 Pure Mathematics 2

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 WMA12_01_2010_ER

General

This paper gave students plenty of opportunity to demonstrate what they had learnt. The work was often well presented and many fully correct solutions to all questions were seen. There were some instances where marks were lost unnecessarily when students had clearly not read the question carefully enough. An example being question 5(b) where candidates sometimes used n = 40, presumably because they had used n = 40 in part (a).

As an overall comment there seemed to be an over reliance by the students on using the integration, differentiation and solving functions on the calculator without showing any working, even when the question says using an algebraic method.

Question 1

This question was generally well done and was a settling introduction to the paper. Many fully correct expansions were seen in part (a), exhibiting excellent use of bracketing and appropriate methods without superfluous working. The most common mistakes observed included ignoring the negative sign and not applying the power to the 4 in $\left(\frac{-x}{4}\right)^n$ sometimes due to omitting brackets, both of which were likely to incur a 2 mark penalty. Less common were errors in the Binomial coefficients with some examiners seeing ${}^{10}C_0, {}^{9}C_1, {}^{8}C_2,$ etc. or the omission of ${}^{10}C_0$ followed by applying ${}^{10}C_2$ to the x term. Some failed to fully simplify their fractions thereby losing all accuracy marks.

In part (b), a significant number of candidates also scored full marks here, however, there were often errors right from the start due to an incorrect expansion of $(3-\frac{1}{x})^2$. Candidates needed to get a three term expression of the correct form to enable them to combine with the first three terms from part (a). Typically, some omitted the middle term and some felt it only necessary to use the 1024 and 9. Some failed to actually add the constants leaving them as a list instead and some could not progress past the expansion. Several had no idea and just left this part of the question blank despite completing the first part with ease.

Question 2

This question was generally answered well. In part (a) the correct values of 0.577 and 0.686 were seen in almost all scripts. Some lost marks due to incorrectly rounding to 0.685 and a very small number felt that when x = 0, y should also be 0.

Part (b) was often a very good source of marks for many candidates. While some did not write out the Trapezium Rule with correct bracketing, their calculation demonstrated that the method was understood and the correct value of 0.624 obtained (this was also achievable from using 0.685). All examiners saw candidates who thought that the strip width was 0.2, obtained from dividing 1 by the 5 points rather than the 4 spaces. Some also made substitution errors in the Trapezium Rule by using repeated y values or even x values. The commonest error was to double the three given values. A small but significant number of candidates appeared to simply not know the trapezium rule.

Mistakes in this question could suggest poor calculator skills (or inequalities in calculator provision). If the Table Function is used for the table then there is an immediate check that they are correct because the given values would match too, and suitability of the final answer is easily checked with calculator integration functions.

Question 3

Most candidates found parts (a) and (b) accessible, achieving full marks in most cases. Any mistakes seen in (a) generally came from solving f(4) = –108 instead of f(–4) = –108 or from sign errors when simplifying. A handful of candidates did not set f(–4) = –108 and instead implied it was equal to zero gaining no marks. Many students did not use the Remainder Theorem and instead used algebraic long division. In many cases this was done well gaining full marks but in others, candidates got lost in the algebra required.

Any errors in part (b) were predominantly numerical when rearranging and simplifying f(1/2) = 0 and a significant minority failed to correctly solve the simultaneous equations. A handful of students incorrectly wrote (a/8) x 8 = 8a

Irrespective of success in parts (a) and (b), part (c) was generally done well. All but the weakest candidates scored this mark where follow through was allowed.

In part (d), a significant number of candidates scored 1 out of 4 by stopping after finding the x-values. Of those who found the correct x values, the majority went on to obtain the correct y values and generally, those with incorrect values for a and b went on to score both method marks in this part. A number of students found the second derivative here setting it to zero and some candidates wrote down their coordinates using y = 0 in both cases. It was pleasing to see that there were hardly any instances of marks lost using rounded decimals for the y values.

Question 4

Part (a)(i) of the question was answered generally well with most candidates able to obtain full marks. When a candidate did make a mistake, it seemed to be due to a mistake in the numerical calculation or from subtracting the coordinates instead of adding.

In part (a)(ii) most candidates were able to obtain at least the method mark here with the usual mistake being due to a sign error. There were a few candidates who attempted the diameter rather than the radius, but most obtained the correct answer by halving at the end. Some candidates forgot to do this and ended up scoring no marks. There were a few answers where they had used the incorrect formula so ended up with no marks.

In part (b), most candidates appeared to know the structure of the equation of a circle, but again many of the candidates who lost marks made careless sign errors. A minority of candidates made errors in the form of the general circle equation e.g. using the diameter^2 instead of the radius^2, not squaring one or both brackets, subtracting brackets instead of adding, and not squaring the radius.

Most attempts at part (c) started with an attempt to find the gradient of the radius, with most of these attempts being successful. The main source of errors here were again from a sign error in either the numerator or denominator. A significant number of responses only gained the first mark, as the gradient of the radius was used for the equation of the required line. Some responses lost the final mark as they left the final answer in the wrong form or had fractional coefficients. A significant number of candidates used point P instead of Q when finding the equation of the tangent and sometimes even used the centre as a point on the required line.

Question 5

This question provided a good source of marks for the majority of candidates. Part (a) was straightforward although some students used the term formula for a geometric progression and others, who did use an arithmetic progression term, used $a + nd$ rather than $a + (n - 1)d$. Some misread the question and found the sum of the first 40 terms instead.

Part (a) was met with equal success and the majority could apply the sum of an arithmetic series correctly. A significant number of candidates clearly didn't read the question carefully and used the same value of n as part (a). These candidates were given the credit of the first mark whilst those who used both n = 60 and n = 40 in the same expression were not.

In part (c), many candidates could at least make a start by forming the correct unsimplified equation but errors were evident with the subsequent algebra. For example, some candidates multiplied both sides by 2 but in doing so effectively multiplied the sum expression by 4 as they multiplied by 2 both inside and outside the outermost brackets. Some errors resulted from using a = 100 (instead of 600), or not setting the expression equal to 18200. Most candidates who used the correct values were able to manipulate the equation into the required form. There were a significant number of candidates who wrote " … (n-1) -10)" which, whilst incorrect could lead to recovery and a correct proof. Most candidates who wrote this did indeed recover and went on to get full marks.

Whilst it was expected that part (d) should cause few problems, it was disappointing to see some candidates determined to solve the question they had found in part (c) rather than the one printed on the question paper.

The interpretation required in part (e) of why there were 2 answers in part (d) was sometimes not articulated correctly although a good deal of latitude was provided in the mark scheme. A significant number of candidates thought the whole question related to a period of 60 months and were credited with stating that the "65" was beyond this period. The majority of correct responses referenced the fact that the loan would already have been paid off in 56 months or that by 65 months, the amount being paid was negative which didn't make sense in the context of the question.

Question 6

This question proved to be quite accessible to the majority of students. Part (a) was often completed well, with the majority of students forming the cubic equation and showing sufficient working to justify the coordinates (2, 5). The question clearly asked for candidates to use algebra and show every step of their working. A variety of approaches were seen including explicit attempts to factorise the cubic using the factor of (x – 1) as well as attempts where candidates clearly used their calculators to solve the cubic equation. These attempts were credited with full marks in this part although some candidates who failed to show any justification why the coordinates were (2, 5) or who had errors in their working but still ended up with the correct coordinates were penalised by 1 mark.

In part (b), the integration was completed well by the majority of students. The main approaches seen were to either find the areas under C1 and C2 separately and then to subtract or to form a cubic expression by subtracting the two expressions first before integrating and applying the limits. The errors seen were often careless in nature, particularly sign errors that resulted from subtracting the two equations or errors when evaluating the integrated expressions using x = 1 and x = 2. A small minority of students clearly used the integration facility on their calculators and showed no algebraic integrations and scored no marks in this part.

Question 7

In part (i), those who knew how to present a 'proof' were generally more successful and many successful succinct proofs were seen. In part (i) the majority used the main scheme method of replacing tanθ by $\frac{\sin\theta}{\cos\theta}$ but the subsequent attempt to make a common denominator was not always successful and a common denominator of sin ϑ + cos ϑ was sometimes seen. Those who obtained $\sin^2\theta + \cos^2\theta$ on the numerator knew the identity well and invariably went onto complete the proof successfully. Occasionally notation errors such as $\sin\vartheta^2$ or $\cos\vartheta^2$ or just $\frac{1}{sincos}$ lost the final mark.

In part (ii), many candidates knew that they needed to divide by 3 and then take the square root although there were a significant number of cases where candidates failed to square root the "1/3". Of those who did reach this first stage correctly, many forgot to take the negative square root. Most but not all were then able to unravel the 2x + 10 in the correct order for the second mark and this mark was available for candidates who failed to gain the first mark. The correct answer x = 22.4 was the most common one found and x = 30.3 was a common incorrect answer from using $\frac{1}{3}$ instead of $\frac{1}{\sqrt{3}}$. Candidates who omitted the negative square root did not obtain a second solution. Some candidates spent a lot of time looking for additional solutions which were outside the range. For those candidates who did proceed correctly to obtain the second angle often rounded prematurely to obtain 57.7° rather than the required 57.6°.

Question 8

The majority of candidates attempted part (a) using the main method in the mark scheme and the small number who used the alternative approaches, scored well. Quite a few mixed up the method for proving the sum of an Arithmetic with the sum of a Geometric series. They wrote the terms with increasing powers of r and then wrote them as decreasing powers of r and then tried to fudge the answer. A significant number started correctly and knew they had to subtract but subtracted the wrong way round to obtain e.g. $S_n - rS_n = ar^n - a$ and a significant number of candidates obtained $S_n - rS_n = a + ar^n$. Quite a few lost a mark as they went straight to $(1 - r)S_n = a(1 - r^n)$ without showing the un-factorised line required for a full proof of the given formula. A disappointing number failed to attempt this standard proof.

Part (b) was usually answered well. There was some careless copying, careless calculations or missing signs but the method was usually clear. A small number used ar^2 and ar^5 which didn't lose them the marks here but did impact on part (c).

In part (c), most found the value of "a" correctly using their answer to part (b) although some lost the marks here for using the wrong terms of the geometric series. However, many went on to get full marks with a correct answer. Students who had calculation errors often scored two out of the three possible marks, however, some did not use the correct formula for S_n, even though it was given in part (a). A common error was to use a wrong value for "n" such as 12 or 14.

Question 9

Part (i) was well done by those students who could manipulate logs. The most popular way of approaching this question was to rearrange the question to give $\log_3(x+5) - \log_3(2x-1) = 4$ and then to rewrite as a single logarithm in the form $\log_3 \frac{(x+5)}{(2x-1)} = 4$. Those students who confidently rearranged to get the single logarithm were then able to rewrite this using indices to give $\frac{(x+5)}{(2x-1)} = 3^4$ (or 81). The typical error if made in the manipulation was to write 4^3 but most students realised that the base of the logarithm and that of the index notation stayed the same. Occasionally further careless errors were made in the algebraic manipulation and some students failed to read the question and did not give the exact answer of $x = \frac{86}{161}$, but instead only gave 0.534 as the answer thus costing them the final answer mark.

In part (ii)(a), only a minority of the students were able to complete this successfully gaining all 4 marks by producing a good coherent proof with no errors. There were 2 distinct ways to approach this question to show that the equation $3^{y+3} \times 2^{1-2y} = 108$ could be rewritten as $(0.75)^y = 2$. The first method was to use rules of indices and the second approach was to use laws of logarithms. Using the method of indices was the more popular approach although a frequently seen error was to combine the 3 and the 2 to obtain $3^{y+3} \times 2^{1-2y} = 6^{4-y}$..
If using indices, students were able to successfully rewrite 3^{y+3} as $3^y \times 3^3$ and 2^{1-2y} as $2^1 \times 2^{-2y}$ or $2^1 \div 2^{2y}$ thus gaining one mark for each. Students were able to then rewrite in the form $\frac{3^y}{2^{2y}} = \frac{108}{27\times 2} = 2$ and often went on to complete the proof although some failed to explicitly show that $2^{2y} = 4^y$ and so forfeited the final mark.
For students using the alternative method the main error was with the log law using log(ab) = log(a)*log(b) to obtain $\log 3^{y+3} + \log 2^{1-2y} = (y+3)\log 3 \times (1-2y)\log 2$ instead of the correct $\log 3^{y+3} + \log 2^{1-2y} = (y+3)\log 3 + (1-2y)\log 2$
A good number of students used the power law correctly though the incorrect use of brackets was often disappointing. Few candidates achieved the 3rd mark when using this method but those that did went on to achieve full marks.

Part (ii) (b) was quite well done with many candidates scoring both marks and most scoring at least the first. A common error was to write -2.41 without sight of the correct -2.409 and a similar error was to round the answer to -2.410