Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

Summer 2025

Pearson Edexcel International Advanced Level
In Further Pure Mathematics F2 (WFM02)
Paper 01A

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

Summer 2025
Publications Code WFM02_01A_2506_ER

Individual Question Reports

Question 1

Full marks on this question were rarely seen, mainly due to students relying on calculator technology despite the instruction stated within the question. Students need to note where the warnings prohibit calculator usage and make sure to show full method, even down to solving quadratics, where the warning is to not rely on calculator usage, rather than the warning to not rely entirely on calculator usage.

In part (a) A large majority of candidates did not show sufficient working, despite the instruction to show all stages, with many simply writing solutions to an unsimplified quadratic before stating roots, which were usually the correct ones. A significant proportion of candidates wrote a factorisation that did not match their written equation, indicating they had used a calculator to solve the quadratic and then "worked backwards" to an incorrect factorisation which was usually by omitting a factor of 2. Deciding on the borderline between what was acceptable and what was not acceptable was challenging but a harsh approach was taken, meaning many missed out on the first two marks. At least the showing of the quadratic formula, or reaching a factorised form, was required to access the method.

A small proportion of candidates multiplied through by $(x – 6)^2$ possibly due to the inequality in part (b) being thought about, but many similarly used calculator to solve. Some showed sufficient working to gain credit but this route was usually less successful that forming a quadratic.

In part (b) the majority of candidates were able to correctly interpret their values from part a) (however they were gained) to obtain the correct follow through region, but a significant minority were not, usually from not considering the presence of the asymptote that was apparent in the sketch of the graph in the question paper.

In the second part, many candidates understood that they were required to solve the "negative version" of the equation from part (a), but again many did not show full details of working, though marks were allowed for writing down the roots in this scenario the equivalent three term quadratic with reverse sign in middle term was reach, as from this point the roots could be deduce as the negatives of those from part (a). Many students solved both equations, redoing the work from part (a) again (in some cases more correctly than they had originally) rather than see the link between the parts, and many reasoned via “regions” where certain terms were positive for the modulus’s rather than use the graph. Those who drew or used the sketch generally fared better. There were a few candidates who used the approach of squaring both sides, though this was not common, and had varying degrees of success – again the full working was not always shown, but there were some elegant solutions from this approach where the difference of squares was spotted.

Students who managed to find all 4 critical values correctly usually then went on to find the correct form of the inequalities and so were able to score at least the method marks as long as their roots satisfied the conditions of the scheme, which was usually the case. Errors in the type of inequality used were very rare, but it was not uncommon to see $x = 6$ was excluded from the solution set.

Question 2

This question proved to be accessible to the vast majority of candidates, with most able to make progress well into part (b), although the final mark was only scored by a small minority.

Part (a) was nearly always completed with ease, with very few incorrect answers seen. A small minority of candidates did not cancel out the (x + 2) from the fraction on the right-hand side, resulting in their function of x not being in the required form. Those who could not do this part tended to have very little marks on the script as a whole.

Part (b) was a quite standard and question and well-prepared candidates had no difficulty finding the integrating factor, knowing how to use this to form the general solution. Very few omitted a constant of integration so most were able to proceed to find the particular solution. A small number of candidates, despite substituting in correct values, made errors in finding the value of c following the integration.

However, most candidates failed to earn the last mark in part (b), failing to write their particular integral in its simplest form. The final particular solution was most commonly written in the form $y = \dfrac{x^3 + 3x^2 - 4}{x + 2}$, with candidates not realising that (x + 2) could be cancelled out from the numerator and the denominator. Some candidates mistakenly thought that simplest form meant they needed to split their answer into 3 fractions and wrote their final answer in the form $y = \frac{x^3}{x+2} + \frac{3x^2}{x+2} - \frac{4}{x+2}$.

The alternatively method was never seen fully correctly carried out, though a few did attempt just a particular integral as per the case noted. Incorrect answers to this part tended to be from students who tried substituting the boundary values into the original equation to find the value for $\frac{\mathrm{d}y}{\mathrm{d}x}$ at $x = 4$ and try a Maclaurin series, or partially substitute to form a simpler equation.

Question 3

Though this question gave good access in early parts, only a minority of students were able score full marks on this question. Most scored full marks in parts (a) and (b), but part (c) was less successful and so a useful discriminator on the paper.

Very clear and precise differentiation was seen by almost all students, and virtually all students achieved both method marks for part (a). Some minor slips in coefficients were seen and missing x's from the chain rule occurred a few times, but only very occasionally were the indices wrong. Notably many of these first derived $\frac{\mathrm{d}y}{\mathrm{d}x}$ rather than using that it is given in the question, creating extra work for themselves. However, errors reaching $\frac{\mathrm{d}y}{\mathrm{d}x}$ were very rare (given it was printed on the paper). A small number of candidates produced correct expressions for their derivatives but were unable to simplify into the required form given in the question, with $A = 96$ being seen surprisingly frequently.

Many candidates also gained full marks in part (b) and usually clear substitution of values was seen, although all too often students substituted directly into the equation with the correct answer implying both marks. Some did not evaluate their expressions and left algebraic expressions in their terms, others did not link the work they had done in part (a) to the Maclaurin expansion and were unclear on how to make progress. A few had a series in powers of $\arcsin 2x$ rather than x as a misunderstanding of what the Maclaurin series is.

Part (c) was less well attempted. Many candidates did not apply the expansion to e^{3x} correctly, or at all, gaining incorrect expressions for this and hence incorrect final answers: some did not include enough terms in an expansion of $(e^x)^3$, others did not evaluate the expression for e^x with x replaced with $3x$ correctly, while quite a few candidates simply tried to apply the given expansion of e^x without considering the $3x$. Of those who expanded e^{3x} correctly, most went on to achieve the correct answer (providing (b) was correct), but a small number were unable to correctly expand their expression, demonstrating inconsistent algebraic manipulation skills. Commonly, a term was lost or discarded when simplifying. A few students with the incorrect "arcsin $2x$' series in part (b) did show the correct method in this part but were only able to gain the initial method mark.

Question 4

Question 4 proved to be more challenging for many candidates than anticipated. It was common to see responses with little or no understanding of the topic being tested, including a significant number of blank responses. The question was unfamiliar from previous papers and shows that many students still struggle to adapt to new situations, much preferring more routine tasks even if they are a bit harder to carry out.

Part (a) did offer some access with a reasonable number of candidates able to identify the correct value, $a = 8$, although some identified the radius as 8 but did not in any way link this to a. A common incorrect approach for a was thinking that the radius was $a = 8^2$.

Likewise, many candidates could correctly identify the value of b, demonstrating an understanding that they needed to find the angle of the half-line equation provided. Often, however, candidates would incorrectly state $b = \frac{\pi}{4}$. Other incorrect values were rare but it is not uncommon to give no value at all for b, identifying just the value of a.

The value of c, in contract, was rarely stated correctly and commonly not even attempted. Occasionally, candidates would attempt to form the Cartesian equation from the given information, often getting lost in the algebra or providing the incorrect value c= 2 from the resulting quadratic equation. Another common incorrect answer $c = 18$ rather than $c = -18$, and answers of ± 14 were also common for c. A dearth of understanding that the locus was one side of the perpendicular bisector of 2i and ci was apparent.

There were also very few completed attempts to part (b). Some candidates picked up the first method mark by correctly identifying one extreme value, usually the closest point in the region to the origin, with fewer were able to deduce the maximum value of |w|. Only a minority were able to identify both extreme values, usually then progressing to the correct range, though a few did not give the range, just the extreme values, which was not acceptable. Candidates were sometimes careless with modulus and inequality signs, forfeiting the final mark despite having identified the key values.

Common incorrect approaches included trying the other intersection points defining the region as where the maximum distance occurred.

Part (c) proved to be the most accessible part of this question and saw many more complete responses, than either (a) or (b) with the majority of students who attempted this part scoring both marks. Candidates were usually able to correctly identify the minimum value of arg w. Occasionally, candidates found angles in incorrect triangles derived from the region. There were still several non-responses to this part of the question, possibly due to candidates struggling with the earlier parts of the question and giving up before they reached part (c).

Question 5

This question was attempted quite well by most candidates. There were, however, a small number of scripts which left this question entirely blank, either unaware of the method of differences in general, or put off by the presence of the logarithms. Most students scored the first mark, but performance was more mixed in the latter parts, though with many fully correct solutions.

Almost all candidates were able to answer the first part of the question correctly, with blank answers being the most common cause of loss of the mark. In the very few cases where an incorrect expression was given this unsurprisingly hampered progress in to the rest of the question, though a couple did manage to recover a correct answer to (b) despite not getting the simplified fraction in (a).

In part (b) many candidates showed a correct process of the method of differences to evaluate the expression, but there was also a significant minority who did not show enough evidence of working yet were still able to "see" the correct answer, so give the correct result. This was especially the case when they approached via combining logs using the addition law but did not evidence it clearly enough. Those who instead separated logs using the subtraction law were far more commonly able to demonstrate sufficient evidence of process usually by showing clear rows written out. Once the correct method was identified, proceeding to the correct given answer usually followed and scores of M1M1A1 and M0M1A1 were the two most common profiles for this part.

Part (c) was commonly done well by those who were successful in part (b). Most candidates were able to use $10n$ and $n + 1$ in a difference of sums and follow up with a correctly formed and solved equation. A small number used $n + 2$ in a difference of sums and were able to score the three method marks. A smaller group of candidates, namely those who had evaluated incorrectly in part (b), ended up in equations which proved either unsolvable, or gave fractional values for n, but the method to reach the equation was usually correct.

There were also several students who did not use a difference of sums, taking the cue from the "hence" in the question, but instead performed a method of differences approach again from $n + 2$ to $10n$ terms (usually by just deducing the new first and last term and realising the intermediate terms would cancel as in part (b)), leading to a correct answer. Since this was related to work in part (b) it was accepted as a "hence" approach.

Cases where a sum was attempted but with the wrong splitting term were seen, usually with $n + 2$ instead of $n + 1$, though a few did use other incorrect terms, such as just n, or even $n + 3$. The latter cases could access the second and third marks only. The work in undoing the base 3 logarithm was done well by those who reach that point, with only a very few using an incorrect process. The most common errors were slips in copying, or minor algebraic slips, the most common being for the $20n + 7$ to become $2n + 7$ between lines of working, resulting in an incorrect and impracticable final answer – something students should be able to identify as incorrect and backtrack to find the error. Given n must be an integer it was surprising how many gave a non-integer solution.

Question 6

Question 6 was a good discriminator on the paper, offering a good challenge to candidates, allowing them to show core differentiation and integration techniques, whilst demanding more intricate thought in how to evaluate the area. Several candidates were able to give an accurate and well laid out complete solution, and the majority made progress deep into part (b). There was only a small number of candidates who did not attempt this question at all.

Part (a) proved to be routine for most students. The vast majority who managed to differentiate correctly (which itself was the majority) went on to gain full marks for this part. There were occasional slips with the differentiation, but these were rare. Occasionally, candidates incorrectly found $\frac{\mathrm{d}y}{\mathrm{d}\theta}$ instead thus gaining no credit, though still these were able to make some progress in part (b). There were a few who took a more unconventional approach, such as rewriting x in the $r\cos(\theta+\alpha)$ form, while some applied a method of finding $\frac{\mathrm{d}x}{\mathrm{d}\theta}=\frac{\mathrm{d}r}{\mathrm{d}\theta}\cos\theta - r\sin\theta$ and $\frac{\mathrm{d}r}{\mathrm{d}\theta}$ separately before combing. Some seemed to be using a variation on this that $\frac{\mathrm{d}x}{\mathrm{d}\theta}=0 \Rightarrow \frac{\mathrm{d}r}{\mathrm{d}\theta}=r\tan\theta$ and equating $\sec^2\theta=\left(\sqrt{3}+\tan\theta\right)\tan\theta$, but often without being directly clear about their method. With all stages of working required to be seen, this risked losing marks if done incorrectly.

Part (b) gave opportunity for candidates to display their skills in problem solving. Nearly all were able to set up the integration for the area of curve C_1 with only very few neglecting the $\frac{1}{2}$ or forgetting to square r. The former of these still saw suitable progress, with only 3 marks often dropped in such cases (the latter could make little further progress save the B mark). The integration overall was accurately carried out, many candidates using the correct trigonometric identities required and obtaining the correct form for the integral. The most common errors were occasional sign errors in the trig identity used for $\tan^2\theta$ or in the integration of the $\tan\theta$ term. It is notable that a significant number of students seem to be memorising that $\int \tan^2\theta\,\mathrm{d}\theta = \tan\theta - \theta$ and quoting this without working, again a high risk strategy in case of errors made.

The last three marks involved a careful consideration of the area required. This part of the question was less well answered. Some candidates added the area of the sector to the integral, whilst others simply did not consider the sector area at all or used the wrong formula in the attempt to calculate it. Some found the sector area but then never used it in combination with the other area at all. Of those who did have a correct method here, few gained a fully correct solution, with the most common issue being the inability to manipulate an otherwise correct answer into the required form, usually due to the ln term not being simplified fully. It was also common for candidates to leave the final solution as a subtraction rather than rewrite as an addition. Despite this, many candidates gained most of the marks in this part of the question.

Question 7

This question provided some very mixed responses with full marks being rare. Each part had its own difficulties, with progress for part (c) somewhat dependent on the outcome of part (b). Overall, perhaps part (b) was the most successful as a result, but the method of part (c) was certainly more routine if a correct answer to (b) was found.

Students were well prepared for this type of question in that many made good attempts at parts (b) and (c) despite struggling with part (a), realising the result carried forward even if they were unable to show it.

Part (a) proved difficult for many candidates, with most attempting the differentiation to get the first derivative but then being unsuccessful in applying their method to obtain a second derivate for the substitution. A lot of candidates did not appreciate an application of the product and chain rules would be required. With a given result to reach there was some creative work forcing the result from incorrect derivatives, attempting to reverse work their derivatives from the answer rather than asking why their answer may not be leading to where they wanted it to. As such careful checking was required. This was a part where work was often incoherent with multiple attempts made, with many students trying to substitute in situ, rather than clearly set out their derivatives first, often missing the product rule completely, trying to replace $\frac{\mathrm{d}^2y}{\mathrm{d}x^2}$ by $\frac{\mathrm{d}^2y}{\mathrm{d}u^2}\frac{\mathrm{d}^2u}{\mathrm{d}x^2}$ and not realising this is a false chain rule. Such students generally only scored the first M mark, since this worked on the first derivative. Those who obtained suitable derivatives were usually able to secure the third M, though some did not eliminate $\frac{\mathrm{d}u}{\mathrm{d}x}$ terms using their initial work, while those who managed to identify correct first and second derivative statements often score full marks for the part.

For part (b) most candidates correctly solved the auxiliary equation and identified the correct form of the CF, which was being generously allowed for the form rather than correct variable. Indeed, many gave the complementary function terms as e^{kx} rather than e^{ku}. Occasionally these would recover later in the part, but often they would leave the answer in terms of x from the start and so end up with an incorrect form for the answer, or in some cases with mixed variables.

Again, most candidates were able to select the correct form of the particular integral and carry out the procedure to differentiate, substitute etc to form the particular integral. A common error at this stage, though, was to incorrectly use $u\mathrm{e}^{2u}$ or a polynomial expression for the form, making no further progress with this part. Again, some worked directly in x at this stage.

Of those who gained the correct complementary function and particular integral, around half did not correctly substitute back and give the general solution in terms of x, instead leaving it in terms of u. Many of those who had given their complementary function as e^{kx} failed to spot their error, and gave a general solution that was of an incorrect form, often mixed exponential and polynomial terms, and often with mixed x and u variables. This then led to a lot of students not being able to score marks in part (c) as they did not appreciate the method of substitution. Most did, however, remember to include the "y =" at the start, so few lost the mark on these grounds. A few who left the integral in terms of u did revert to x at the start of part (c), when they realised they need to be in terms of x, and were able to recover the mark. Even so, success on this part was limited and also by consequence hampered progress in part (c)

Part (c) was attempted by most candidates who had gained a general solution, although this varied greatly in success. Since most of the marks were for method, considerable progress could be made as long as the form of the general solution was suitable, but many lost the first M due to the incorrect form noted in part (b) with x introduced too early. However, the next three marks were accessible for the process. The most common problem at this stage was use of x in place of u in solutions that had not reverted to x. Although some found the relevant value for u at $x=\frac{1}{4}$, many did not find the corresponding value for $\frac{\mathrm{d}y}{\mathrm{d}u}$, and indeed often differentiated with respect to u but called it $\frac{\mathrm{d}y}{\mathrm{d}x}$. Such attempts locked themselves out of the final four marks, where correctly associated values to the variables was required, though they could gained the first M for the form in such instances as long as did not have an equation with mixed u's and x's from part (b). Those who were working in terms of u and remembered to also find $\frac{\mathrm{d}y}{\mathrm{d}u}$ at $x=\frac{1}{4}$ were generally good students and went on to get full marks for this part (though they had lost a mark at the end of (b) for neglecting the solution in terms of x).

Of those who did have an equation in x only from part (b) (whether correct or incorrect), most candidates were able to attempt a derivative and form and solve 2 equations to find the constants. The second and third M's usually were both scored in these instances, but not all students formed solvable equations, so some stopped short of solving.

Among those who successfully proceeded as far as finding the constants in the general solution successfully, most went on to find the value of y when $x = \frac{1}{8}$ and many did find the correct values, though there were a few who thought the particular solution was all that was asked for and so did not evaluate at $x = \frac{1}{8}$ at all.

Question 8

Candidates again had mixed levels of success with this question with the earlier parts of the question proving to be more accessible than part (c), which was often not attempted at all, or proceeded no more than setting up the integral.

In part (a), one mark out of the two marks was the most common score, but erratic or incomplete work often prevent both marks being secured. The majority of candidates were able to apply de Moivre's Theorem to write at least $z^n = \cos n\theta + \mathrm{i}\sin n\theta$, and in most cases also $z^{-n} = \cos n\theta - \mathrm{i}\sin n\theta$, but the explicit addition of these was often not seen, leading to many candidates losing the A mark in part (a). Alternatively, many did not show the left-hand side of the identity in their work and so lost the accuracy as the minimal requirement was not seen. The Alternative method in the scheme was only rarely seen but usually correct if attempted.

In part (b), candidates should take note that the question states 'hence', so part (a) must be used to answer this part of the question, and alternative methods are not guaranteed to score marks. Though most did attempt the method that the question was requiring, there were also many who used the alternative scheme and of these few it was rare for them to achieve more than the first M mark for applying the binomial expansion since they did not relate to part (c) in the work. A few simply tried to expand from the double angle formula for cos2x, not even applying the binomial formula and completely ignoring the question part (a), and these score no marks at all for this part despite often achieving the correct identity.

For those who proceeded by the expected route, the expansion of $\left(z+\frac{1}{z}\right)^4$ was very well done, with most candidates reliably obtaining the correct terms. The most common mistake in part (b) was seen in the next step, where many students failed to show the grouping of terms required for the method, and so lost the second method mark – though these often did recover the final M and A marks. Another common error was to replace $z^4+\frac{1}{z^4}$ correctly with $2\cos 4\theta$ but then replace $4\left(z^2+\frac{1}{z^2}\right)$ incorrectly with $4(\cos 2\theta)$. In this case the final accuracy mark would also be lost, but the first and third methods usually were gained. Other minor slips occasionally occurred, such as incorrectly obtained $2^4=8$ when trying to evaluate the left hand side (often coupled with incorrect applying the formula to get $\cos 4\theta$ instead of $2\cos 4\theta$ when applying the result of (a)).

Part (c) was a very challenging conclusion to the paper with many failing to progress beyond the first mark. Most were able to identify the volume of revolution formula correctly, though numerous cases of $\frac{1}{2}$ or 2π instead of π at the start were seen, as well as some other multiples. Determining y^2 was more secure with fewer failing to get this bit correct, although a few did omit to square, and so were unable to proceed. But many did reach an integral from which progress was possible.

Processing the integral was troublesome for most, though, with many failing to link the answer to part (b) to the problem, as well as many who had reached $\cos^4 x(1+\sin x)$ multiplying the $\sin x$ by their answer to part (b) as well making the last "term" much more complicated and often failing to progress.

Those who did make the connection with part (b) were usually able to partially carry out the integration on the answer to (b) and gain a second mark, and possibly the dM mark depending on how far they progress. But the $\sin x \cos^4 x$ proved more problematic. Very few spotted this a reverse chain rule integral – those who did often scored the first 5 marks, though few simplified correctly to the form required. Far more often this would be expanded using the result of part (b) again and result in copious amounts of work trying to integrate all the terms. Some did labour and come up with alternative correct variations, but many simply stopped at this stage and did not complete the question. Other incorrect process at this included trying to use a false "product" rule on the integral, for instance integrating the $\sin x$ and the $\cos^4 x$ (incorrectly) and multiplying the result.

A few candidates missed the instruction to use part (b) of the question and used expanded the integrand using double angle identities, so could not score the second M. They had similar difficulties with the $\sin x \cos^4 x$ term and usually met with no more success on this part of the integral.

Students who succeeded in scoring at least one of the marks for integration and persisted in trying to integral fully would usually score the final method mark, with the correct limits applied – seldom were incorrect limits seen, though a few did try to integrate from 0 to $\frac{\pi}{2}$ and double the result.

Fully correct answers to this question were rare.

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