Pearson Edexcel

Examiners' Report

Principal Examiner Feedback

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Pearson Edexcel International GCE

In Further Pure 2 (WFM02)

Paper : 01 Further Pure F2

General

It was very pleasing to see that the majority of candidates were well prepared for this examination in spite of the trials of the preceding months. The main problems were seen in questions 3, 5, 7(b) and 8(a) – this was as expected. Also there was the usual tendency to reach a given answer by any means possible, legitimate or otherwise, in some cases even simply following a small amount of working with the required result, leaving a significant amount of working out. Candidates should realise that examiners do look carefully at the work presented to them.

Report on individual questions

Question 1

This proved to be a straightforward question which gave most candidates a confidence boosting start to the examination although marks were lost by candidates who did not explicitly give an expression for $\frac{d^3y}{dx^3}$ in part (a) as demanded by the question or those who gave their answer to part (c) as f(x) = … rather than y = … without earlier connecting f(x) to y.

Question 2

This question was well answered on the whole with the vast majority of candidates obtaining the correct partial fractions although candidates would be well advised to check their answers in such questions as an arithmetical slip in part (a) has dire consequences for the rest of the question. Almost invariably incorrect partial fractions do not give rise to the diagonal cancelation needed in part (b). This problem did not seem to alert many candidates to their error. Candidates also lost marks in part (c) by not showing enough working to show that they had used a result from their part (b) rather than just summed the relevant terms.

Question 3

The responses to this question were disappointing overall. A considerable number of candidates just considered the case mod $a = b$ and ignored mod $a = -b$ and so only achieved two of the three critical values. Even those candidates who obtained all three critical values were not guaranteed to combine their values correctly. Of those who did obtain the final ranges correctly most did so by using intermediate values of x and checking arithmetically whether that value satisfied the inequality although some did consider the graph of the relevant function.

Question 4

Part (a) very was accessible to most candidates. They were able to find the modulus easily but a small minority did not find the correct principal argument and hence lost the final accuracy mark. Some final responses came with the trigonometric form incorrectly written as $36\left(\cos\frac{\pi}{6} - \sin\frac{\pi}{6}\right)$ which again lost the final accuracy mark.

Part (b) was also very well answered by the majority of candidates. Most were able to apply de Moivre's theorem and correctly apply a method to find the four roots, usually gaining all the marks. A common error was not finding $\sqrt[4]{36}$ correctly – 3 was seen far too frequently.

Question 5

This question proved problematic for many candidates, with less than half gaining full marks. The first few method marks were obtained by most; almost all were able to rearrange the equation to make z the subject. Most then put the modulus of this equal to 1 and substituted $w = u + \mathrm{i}v$. However not all candidates found the correct moduli (or square of them) and were only able to gain the first two marks. Those who went on to find the correct circle equation were usually able to complete the square and find the correct centre and radius. However, there were errors seen with some not dividing their initial circle equation by 3 fully and hence ending up with the wrong circle equation, centre and radius.

Question 6

This question discriminated fairly well between candidates with around half gaining full marks. Some candidates did not fully divide the equation by x^2, and so lost the first mark. Most tried to find an integrating factor (IF) of the correct form, with some gaining the correct IF. It was disappointing to see so many incorrect IFs, which resulted in these candidates only gaining one more mark by multiplying through by their IF, but then trying to integrate some complicated functions. The majority of those with the correct IF finished the question very well, with correct integration and treatment of the constant.

Question 7

This question was a good source of marks in part (a) but the later marks in (b) were more discriminating.

Part (a) required finding the polar coordinates of the point of contact of a tangent to a polar curve, where the tangent was parallel to the initial line. Most students realised they needed to solve $\frac{\mathrm{d}}{\mathrm{d}\theta}(r\sin\theta)=0$ although a small number thought solving $\frac{\mathrm{d}}{\mathrm{d}\theta}(r\cos\theta)=0$ was required. Occasionally the required $\frac{\mathrm{d}y}{\mathrm{d}\theta}$ was found using $y=r\sin\theta \Rightarrow \frac{\mathrm{d}y}{\mathrm{d}\theta}=\frac{\mathrm{d}r}{\mathrm{d}\theta}\sin\theta+r\cos\theta$. A small number of candidates unnecessarily found $\frac{\mathrm{d}x}{\mathrm{d}\theta}$. However most obtained and differentiated $r\sin\theta$ correctly using the product rule or via $\sin 2\theta = 2\sin\theta\cos\theta$ and the correct three term quadratic in $\cos\theta$ was usually reached. Those who obtained the correct 3TQ generally proceeded to find the correct value of θ and invariably the correct r followed. It was rare to see any candidate who did not reject the $(\pi, 0)$ solution although occasionally θ was greater than $\frac{\pi}{2}$.

In part (b), most used the correct area formula although a few lost the $\frac{1}{2}$ from $\frac{1}{2}\int r^2\mathrm{d}\theta$. The expression for r was almost always squared correctly. As with the differentiation in part (a), only a few slips were seen with the required use of $\cos^2\theta = \frac{1}{2}\cos 2\theta + \frac{1}{2}$ and the subsequent integration. A small number who used the trigonometric identity and also integrated in one line of working forgot to integrate the $\frac{1}{2}\cos 2\theta + \frac{1}{2}$ terms. Many errors involved mishandling of the constant a from the curve equation. Those who didn't move the a^2 to the left of the integration sign were particularly vulnerable to this. The majority knew to use the limits of their $\frac{\pi}{3}$ and $\frac{\pi}{6}$ and substitution with correct subtraction was usually seen. A small number used the limits $\frac{\pi}{3}$ and 0 followed by subtraction of the result of applying the limits $\frac{\pi}{6}$ and 0. However, the main misconception seen was that many candidates believed that they had now already found the area of the shaded region R. A relatively small number knew that they had to subtract the area of the triangle OAB and most who attempted this found the correct expression. The $\frac{1}{2}$ from $\frac{1}{2}ab\sin C$ was occasionally missing. A few more protracted attempts at the area of this triangle were seen – such as dropping perpendiculars to the initial line from A and B to form a trapezium $ABQP$, finding its area and then adding the area of triangle OAP and subtracting that of triangle OBQ. Some succumbed to algebraic errors in the last few steps but it was encouraging to see plenty of fully correct and well-organised solutions.

Question 8

This question on a second order differential equation saw a good number of completely correct solutions although part (a) predictably proved a challenge to many.

In part (a), those who identified that the best strategy was to directly replace the derivatives in y with respect to x with those in y with respect to u were much more likely to be successful. The first two marks for differentiating $x = e^u$ (or $u = \ln x$) and for use of the chain rule for a first derivative were widely scored. Obtaining a second derivative was more challenging – most knew to apply the product rule but failing to use the chain rule when differentiating was a common error. Those who obtained the correct $\frac{d^2y}{dx^2}$ almost always were able to substitute into equation (I) to obtain the given result. Candidates who decided to find the derivatives of y with respect to u were often left confused as to how to proceed. Some extra work was needed to go on from there to show that equation (I) ⇒ (II). Indeed, some substituted into equation (II) and then offered the given answer. The acceptable option of showing (II) ⇒ (I) was not common.

As expected, a significant number of candidates were completely ill-prepared for this part of the question and many very poor quality attempts at "fudging" the answer were evident. Misconceptions included thinking that the chain rule for first derivatives also worked when first derivatives were replaced with second derivatives. However, on the whole, a commendable amount of succinct proofs was seen.

Scoring was very good in part (b). It was rare to see an incorrect auxiliary equation although many unnecessarily showed its derivation from $y = e^{mx}$. The quadratic was almost always solved correctly and was usually followed by the correct form of complementary function. Most knew the method from here and looked for a particular integral, but a common pitfall was to choose the form of the particular integral to be $y = \lambda u$. Many chose $\lambda + \mu u + \nu u^2$ instead of $\lambda + \mu u$ but were generally not much more prone to error. There were a few basic mistakes (usually sign errors) when obtaining the constants. Most added their CF and PI but some were working with mixed variables here. The part (c) mark for the correct solution in the form $y = f(x)$ was widely seen although again variables were occasionally confused. A small number gave away a mark they could easily have scored by carelessly omitting the replacement of the u in $-\frac{1}{2}u$ with $\ln x$. It was also unfortunate to see students losing achievable marks by giving answers starting with "CF + PI =" or "GS =" rather than "y =".