Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

Summer 2019

Pearson Edexcel International A Level
In Further Pure M3 (WFM03/01)

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Introduction

This paper proved to be a good test of student knowledge and understanding. It discriminated well between the different ability levels. There were many accessible marks available to candidates who were confident with topics such as conic sections, hyperbolic functions, integration, vectors and matrices.

Reports on Individual Questions

Question 1

Although a few slips were seen the majority of candidates emerged with all six marks here. In the first part, $\pm\sqrt{27}$ was occasionally given for the value of a. In part (b), a few candidates did not give their answer as equations for the directrices. Weaker responses included those using incorrect identities such as the eccentricity formula for an ellipse. A very small number confused e with the base of natural logarithms.

Question 2

In part (a), both (i) and (ii) were well answered with the majority sensibly working from right to left. A small number offered proofs that did not involve the exponential definitions of sinh and cosh and so could not score the marks available.

Part (b) was also a good source of marks for almost all. The last mark was less accessible since candidates occasionally missed the negative solutions if they used the logarithmic form of arcosh rather than exponentials. Those who attempted to use exponentials before solving for cosh x often reached a quartic in e^x but generally made no further progress.

Question 3

The two integrations required here were completed successfully by the vast majority. It was rare to see any candidate attempt to progress without first completing the square for the quadratics. Full substitutions were not common with most using the forms from the formula book. The multiplier of $\frac{1}{2}$ was occasionally missing in final answers to part (a). Part (b) saw slightly more errors – often from the erroneous extraction of a minus sign beyond the square root and arithmetic errors when attempting to complete the square.

Question 4

This arc length question produced a slightly more mixed response. In part (a) most obtained the correct $\frac{\mathrm{d}y}{\mathrm{d}x}$ and used the correct formula to reach the correct integrand. A common error was to integrate $\cosh\frac{x}{3}$ into $\frac{1}{3}\sinh\frac{x}{3}$ rather than $3\sinh\frac{x}{3}$. Some who used $3a$ and $-3a$ as limits did not give their answer as a multiple of $\sinh a$, leaving it as $3\sinh a - 3\sinh(-a)$. Most went on in part (b) to use the given arc length to obtain a value for the required x-coordinate of $3a$. In (c), the majority successfully obtained a value of the y-coordinate of $3\cosh a$ using the exponential definition of cosh with only a small number unable to obtain it in the right form. The more direct route of using $3\cosh a = 3\sqrt{1 + \sinh^2 a}$ was not widely seen.

Question 5

Although many fully correct solutions were seen, this vector question discriminated as expected. The tasks involved were fairly standard ones but many candidates were clearly ill-prepared for them.

It was common to see a correct normal in part (a). However, many did not appreciate the need to find the direction of line l in part (b). A correct value for the scalar product divided by the product of the magnitudes was often achieved but it was common to see confusion about what trigonometric function and of what angle (α or $90 - \alpha$) this should be equated to. Occasionally an otherwise correct final answer was not given to the nearest degree. A vector product approach was rarely seen. A very small number used their answer to part (c) followed by right-angled trigonometry.

A wide range of methods were viable and all were seen to some extent in part (c). The parallel plane method was the most common, often in combination with use of the distance formula. The arguably easier routes of calculating $\sqrt{38}\sin\alpha$ or using $\frac{\overrightarrow{AP}.\,\mathbf{n}}{|\mathbf{n}|}$ were not quite as common. Many confused responses were seen from candidates unsure of an appropriate strategy.

Question 6

This matrix question was a good source of marks, particularly in parts (a) and (b). The methods for finding eigenvalues and an eigenvector were well known and few slips were seen. The most common source of errors was in the handling of the equations in part (b).

There were many correct solutions to part (c) but again despite this transformation being a task that has been seen many times in exams for this module, some were unsure about the method.

A common pitfall was to calculate the cross product of **a** and **b** and to apply **M** to the resulting vector. Some others succumbed to confusion over the points and directions of the lines.

Question 7

This reduction formula question saw good scoring for the most part. In part (a), most sensibly opted for Way 1, performing the "split" correctly and applying parts in the correct direction. The most common error occurred when differentiating $\cosh^{n-1}x$, obtaining $(n-1)\cosh^{n-2}x$ rather than $(n-1)\cosh^{n-2}x \sinh x$. Those who obtained the required $\sinh^2 x$ invariably replaced it with the correct $\cosh^2 x - 1$. A few sign errors were seen but most who scored the first three marks had little difficulty reaching the given answer correctly. Those who used the Way 2 "split" were far more likely to encounter difficulties such as knowing how to apply parts correctly to integrate $\sinh x \sinh x \cosh^{n-2}x$.

It was common to be awarding marks in part (b) even for those who made little progress in (a). Most used the reduction formula twice and obtained the correct I_0. Only a small number found I_2 directly. Errors usually revolved around slips with bracketing leading to incorrect coefficients.

Question 8

The final question on an ellipse was fairly discriminating, particularly in part (b), but a substantial number of candidates scored most of the marks here.

In part (a), most eliminated y and expanded $(mx + c)^2$ correctly but then some did not realise the need to use the discriminant. Those that did, often went on to achieve the given answer with no errors although some got bogged down in the algebra. It was rare to see the alternative verification of the result using a parameter. Some weaker responses merely found $\frac{dy}{dx}$ or attempted the equation of the tangent but made no further progress.

Some candidates did not offer an attempt for part (b) but it was relatively common to see the correct coordinates for the intercepts and an appropriate expression for the area. Some could not progress from this point but many did use the result in part (a) to establish an expression for the area in one variable, usually m. Those who did further work usually differentiated their expression correctly, set it equal to 0 and solved for m. The last mark proved quite hard to score since many did not correctly handle the fact that m was negative and that the minimum area occurred when $m = -\frac{b}{a}$. A significant number of candidates were successful using parametric coordinates. Those who obtained the correct $A = \frac{ab}{\sin 2\theta}$ often went on to score all the marks provided they had a valid argument to show that this produced a minimum area of ab.

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