L-Università ta' Malta

MATSEC
Examinations Board

Examiners' Report

Advanced Level Pure Mathematics

Main Session 2024

Summary of Results

Grade	A	B	C	D	E	F	Abs	Total
Number	59	110	122	39	27	101	43	501
%	11.8	21.9	24.3	7.8	5.4	20.2	8.6	100

Grade	A - C	A - E	FAIL
Number	291	357	101
%	58.0	71.2	20.2

Comments on Candidates' Performance

Paper 1

Question 1. 57% of the candidates got exactly 3 marks in this question. This means that they just managed to get part (a) correct without being able to use it to work out part (b). Only 26% managed to get 5 marks or more. The rest of candidates did not use grouping to factorise the right hand side of the differential equation.

Question 2. A significant number of candidates did not simplify the logarithmic function given in part (a) resulting in many incorrect answers for the first and the second derivatives. In general candidates performed better in part (b) where in most cases they managed to obtain the correct expression for the derivative. In fact 66% got 5 or more marks in this question, mainly from part (b). However, there was a significant number of candidates who despite getting the correct derivative and finding the correct coordinate, they erroneously gave the equation of the normal instead of the tangent.

Question 3. In general candidates performed well in this question especially in part (a). The only issue in this part was where candidates had to give the range of $f \circ g$, where in a significant number of cases the y-intercept of the curve or the x-coordinate of the turning point were given as the lower bound of the range. In part (b) they performed worse compared to part (a), where a significant number of candidates did not use the discriminant to obtain a correct answer. One can also add that no one deduced the answer from the range of part (a).

Question 4. In part (a) of this question many candidates failed to integrate properly despite the fact it involved a very simple integral by substitution, where the substitution was given. In most cases they had issues in simplifying the derivative of the substitution. In fact 54% got less than 5 marks. Still some of those candidates who got part (a) wrong managed to integrate the same expressions in part (b) without using the given substitution. This shows that the main issue was with the substitution. Despite giving a correct answer to part (b) some candidates failed to answer part (c) correctly even when the only task they had to do was to substitute the given limits in the answer of part (b).

Question 5. In general candidates performed very well in this question where 58% got 5 marks or more and 33% got even more than 8 marks. Most candidates answered part (a) correctly, however a significant number of them got the incorrect value for α because of algebraic mistakes as in most cases they used the correct method. In part (c), although it was not necessary, a significant number of candidates opted to use the cross product to find the required area, however in many cases failing to use it properly. A common error was that after denoting the cross product, candidates simply multiplied the magnitude of the two vectors as if they are simply taking the product of two real numbers.

Question 6. The majority of candidates answered part (a) correctly. Although a reasonable number of candidates answered part (b) correctly, some started off by assuming the result that had to be proved, and ended with the result that was given. In (c), the majority started off well, writing $\tan 3\theta$ as $\tan(2\theta+\theta)$. The majority of those who did not answer this part correctly then substituted -1 for $\tan 2\theta$. In (d), most candidates once again started off well, but minor mistakes led to a wrong cubic equation. Others did not show the working for the solutions of the cubic equation and only a few candidates used part (b) to solve the quadratic factor which eventually resulted in (d).

Question 7. A good number of candidates answered part (a) correctly. Others just found the number of sequences of four dashes and dots. Some were unsure whether or not to include a sequence of one dash/dot since the question stated a sequence of dashes and dots. In part (b), the majority considered sequences starting with two dots, sequences ending with two dots, sequences having dots in the 2^{nd} and 3^{rd} position and sequences having dots in the 3^{rd} and 4^{th} position, but did not realise that the first two cases had a common sequence, thus ending up with 12 sequences instead of 11. However, a good understanding of the question was shown by the majority of candidates.

Question 8. A good attempt was made at (a). On the other hand, quite a number of candidates ended up with incorrect partial fractions in (b), mostly due to them changing the

sign of the given cubic or finding the wrong quadratic factor. Quite a number seemed to assume, without showing any working, that $x-1$ was a factor of the given cubic. This year it was once again noted that to find the unknown constants, a small number of candidates first compared coefficients, ending up with three equations involving three unknowns, then listed two or three different methods of solving these equations but in actual fact did not apply any of the methods they described to solve for these unknowns, and just stated the answers without showing the actual working. In part (c), very few reached the correct answer, however marks were allotted for the correct expansion of $(1-x)^{-1}$ and $(1+x^2)^{-1}$. Difficulty was shown in deriving the range of values of x for which the expansion of $(1+x^2)^{-1}$ is valid.

Question 9. Very few candidates answered part (a) correctly, with the vast majority stating that $b^2-4ac \geq 0$. A lot of these candidates then did not change sign when dividing their inequality by a negative number. Only a handful of candidates mentioned the fact that the curve had to be a minimum, in which case k had to be greater than 1. In (b), the majority differentiated correctly but very few managed to reach an inequality similar to that in (a). Very few explained how the denominator in their inequality suddenly vanished. All marks were lost in instances were the first derivative was confused with the inverse.

Question 10. Most candidates did well in this question, however some did not determine the coordinates of the midpoint in (a) correctly. Part (b) was generally well attempted. In (c), some candidates insisted on using the learnt-by-heart general matrix for a reflection in a line through the origin to determine the required matrix, and although no marks were lost, drawing a simple diagram to find the images of $(1,0)$ and $(0,1)$ would have been preferred. Various methods were applied to determine the equation of the image circle, but quite a number failed to reach the final correct answer due to wrong matrix multiplication when finding the image of the centre or due to a wrong transformation matrix.

Paper 2

Question 1. This question was extremely popular with the candidates. In fact, 96.5% of the candidates chose this question. Moreover 32% of the candidates who attempted this question got full marks. With respect to 1(a), there were some who wrote that the integrating factor is $e^{\int \tan x\,dx}$ instead of $e^{-\int \tan x\,dx}$.

Question 2. 22% of the candidates did not attempt this question. The first part of this question (a)(i) was straightforward. But to get the first four non-zero terms in the Maclaurin series for $f(x)$, some candidates used erroneously the standard expansion of $\ln(1-2x)-\ln(1+x)$. With respect to part (b), candidates had to construct the table to

draw the graph. But they wrote the values of θ in radians and then they used their calculator which was in degree mode.

Question 3. Some of the candidates who attempted this question did not write $\int \sin^n x\,dx$ as $\int \sin x \sin^{n-1} x\,dx$ before starting to integrate the given function. In part (b), many correctly made use of the given expression in part (a) to evaluate the $\int \sin^n x\,dx$ for $n = 2,4,6$. Many of these candidates knew the formula for the volume of revolution but only a few obtained the right answer.

Question 4. Only 21.7% attempted this problem and out of these 23% got no marks. They did not understand the three events. But on the other hand, there were 9 candidates who got 15 out of 15. Most candidates may have difficulties in understanding the principle of events and prerequisite concepts. Vocabulary related to probability, such as certain, likely, and unlikely, can also be challenging for candidates to understand and use appropriately,

Question 5. Most of the candidates who attempted this question were able to find the point of intersection A of ℓ_1 and the plane Π_1 but only a few obtained the equation of ℓ_2 correct. Many of these candidates did not find the direction vector of ℓ_3 and so were not able to work out the equation of this line.

Question 6. Only a few candidates tackled this question. Many of them only managed to express w in the form $a + ib$ and did not solve part (b) or (c) of this question.

Question 7. This was a question attempted by the majority of the candidates and many obtained a good mark for it. However there were candidates who made mistakes when differentiating the given function in order to show that there are no stationary points. Those who solved correctly parts (a) to (d) sketched the curve correctly.

Question 8. Nearly all candidates attempted this question. Many obtained high marks but only a few were able to differentiate $\ln(1+e^{-x})$ and/or integrate the expression

$$e^{-x} - \frac{1}{2}e^{-2x} + \frac{1}{3}e^{-3x} - \cdots.$$

Question 9. This question was attempted by 72.3% of the candidates. Also 32 candidates out of a total of 446 got 14 or more for this question. With respect to part (a), many had quite a good idea of the steps involved in mathematical induction, but some did not correctly show that $(1+kx)(1+x) \geq 1+(k+1)x$. They did not realize that the term kx^2 is always positive. Responses given in question (b)(i) indicated lack of knowledge how to expand the given series up to the n^{th} term.

Question 10. 71.3% attempted this question and there were 7.2% candidates who got 14 or more marks (out of 15). In part (a), many obtained the correct answer. For part (b), many of the candidates who tackled this question knew the steps that they had to do. But there were quite a few candidates who considered the column matrix

$$\begin{pmatrix} -3\frac{1}{2} \\ 5\frac{1}{2} \\ 5 \end{pmatrix} \quad \text{as} \quad \begin{pmatrix} -\frac{3}{2} \\ \frac{5}{2} \\ 5 \end{pmatrix} \quad \text{or} \quad \begin{pmatrix} -\sqrt{3} \\ \sqrt{5} \\ 5 \end{pmatrix}.$$

Hence their answer was incorrect. With respect to part (c), very few candidates checked the two values of k for having infinite solutions. Also, there were some candidates who wrongly solved the simultaneous equations without using matrices.

Chairperson
Examination Panel 2024