FURTHER MATHEMATICS

General Certificate of Education (New)

Summer 2022

Advanced

FURTHER PURE MATHEMATICS B – A2 UNIT 4

General Comments

The candidates performed very well on a high number of occasions and there were some excellent scripts. However, some candidates encountered difficulties with the requirements of some questions and poor algebraic skills were often seen, leading to low marks being awarded.

Comments on individual questions/sections

Q.1   This question was the least well-answered question on the paper. In part (a), candidates seemed unprepared to differentiate $\cosh^3 x$ using the chain rule, with many candidates changing this into $\cosh^2 x \cosh x$ and then proceeding to use a $\cosh 2x$ identity. Candidates then used the chain rule to differentiate $\cosh 2x$ as part of a product. Some candidates used the exponential form of $\cosh x$. However, errors with the identities were seen frequently, leading to candidates losing accuracy marks. In part (b), candidates often found the second derivative and its value when $x = 0$, which was 0, and then continued on to state that this was a point of inflection.

Q.2   This question was answered poorly, with many candidates finding four fourth-roots, almost on auto-pilot. Few candidates realised there was a quicker method available, or that, if they did find the fourth-roots, that only two (separated by 180°) were required to calculate the radius.

Q.3   This question was one of the best-answered questions on the paper. Most candidates used the information from the Formula Booklet in part (a) to derive the required equation. In part (b), not all candidates showed sufficient working to solve their equation, and some candidates factorised incorrectly, often resulting in only one value of t.

Q.4   Most candidates gained full marks in this question. However, some candidates tried to work with πx^2, changing the limits and trying to integrate $\sin^{-1} x$, running into difficulties.

Q.5   Many candidates started well using row operations. However, some candidates failed to reach a row of 0 values, or made arithmetic errors. Other candidates, having reached a row of 0 values, did not interpret this correctly.

Q.6   Many candidates used the factor formula well to gain the initial marks. Some candidates seemed unfamiliar with the odd-function nature of $\sin \theta$ and worked with $\sin(-\theta)$ throughout; full marks were awarded if they correctly dealt with this. Other candidates cancelled through by $\sin \theta$ and lost solutions, and accuracy marks. While other candidates noted the general solutions, rather than the angles in the required range.

Q.7   In part (a), the majority of candidates were able to express the quadratic in the required form. However, some errors were made in obtaining the value of c, which was disappointing given that this skill is from GCE Mathematics Unit 1. In part (b), many candidates performed well, noting the connection between parts (a) and (b), with the main errors coming from extracting a factor of $\sqrt{4}$ from the denominator.

Q.8   This question was attempt by the majority of candidates by using the exponential form of $\sinh y$ and forming a quadratic equation in e^y to solve, but a few candidates worked with the identity $\cosh^2 y - \sinh^2 y = 1$. In both instances, candidates rarely justified their choice of the positive square-root, losing the final mark.

Q.9   In part (a), many candidates used the binomial theorem to expand the bracket correctly, although some changed it to (C + iS)²(C + iS) or (C + iS)(C + iS)(C + iS) first, which often lead to errors. Furthermore, some candidates' use of de Moivre's theorem was unclear, such as why they chose the Real terms. In part (b), most candidates made use of the result in part (a), although most divided through by $\cos \theta$ without explaining why this was possible in this question, losing an accuracy mark. Furthermore, few noticed that the two possible general solutions could be combined, which lost the final mark.

Q.10   This question was a high-point for many candidates and was the best-answered on the paper. Full marks were often awarded. In part (a), errors occurred in calculating the determinant, particularly multiplying with 0, or solving their quadratic equation. In part (b), not all candidates seemed familiar with the term 'adjugate', with the cofactor matrix often given as the adjugate matrix.

Q.11   In part (a), (i) was answered very well, with the chain rule and product rule used effectively. However, (a)(ii) proved more problematic. Many candidates used the $\cosh 2x$ identity to rewrite the question before attempting a differentiation – any valid method was credited if used correctly. Whilst many candidates arrived at a correct derivative, some had errors in using the chain rule twice. In part (b), many candidates rearranged the equation into $y = \sqrt{\sinh x}$, rather than using implicit differentiation. Unfortunately, few candidates noted both $\pm$ options of the square-root, losing marks in the differentiation and values of y, $\frac{dy}{dx}$ and the equations of the tangents.

Q.12   This question proved to be a highlight for many candidates, with many good responses seen. However, carelessness on occasions with arithmetic lead to accuracy marks being lost. On some occasions, an inappropriate particular integral form was chosen and, sometimes, candidates failed to include their particular integral in the equation they were differentiating, losing many marks.

Q.13   In part (a), few correct sketches were seen. In part (b), most candidates used $y = r\sin\theta$, but not all, with some errors occurring in finding the derivative. In solving the trigonometric equation, some candidates did not state why they ignored the solution of $\cos\theta = \frac{1+\sqrt{3}}{2}$, while others only found one angle from $\cos\theta = \frac{1-\sqrt{3}}{2}$, losing accuracy marks.

Q.14   This question was answered well by those who realised that partial fractions were required. However, a large number of candidates tried to use a substitution involving the denominator. Some candidates also stated the numerical answer without working – candidates should be reminded that answers without workings are rarely credited.