FURTHER MATHEMATICS

General Certificate of Education (New)

Summer 2019

Advanced Subsidiary/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 in these questions.

Comments on individual questions/sections

Q.1 Many candidates answered part (*a*) well. Whilst part (*b*)(i) began well, with the majority of candidates finding the cube roots, few candidates stated their roots as coordinates, thereby losing the final mark. It was disappointing to see 'isosceles' appear more often than 'equilateral' as the name of the triangle formed by the cube roots, with some candidates attempting to find the length between vertices to support their answer.

Q.2 Part (*a*) was answered well by many candidates, although some candidates did not show all their working. When results are given in the question, candidates are reminded to show sufficient working to 'convince' the examiner, as noted in the mark scheme. Part (*b*) often began well, although some candidates did not show their working for solving the quadratic equation. Some candidates doubled their value of x before using the general form, losing the final mark.

Q.3 In part (*a*), the majority of candidates used the determinant method for determining whether a set of equations has a unique solution. Those who used this method usually gained full marks. Those candidates who used the echelon form method sometimes failed to give a sufficiently detailed statement to gain the final mark. In part (*b*), Method 3 (inverse matrix method) proved to be the most popular, and this method was very successful. Those candidates who used the other two methods often ran into algebraic manipulation errors, leading to a loss of accuracy marks.

Q.4 In part (*a*), candidates often began well and accuracy marks were awarded for each of the steps, irrespective of the order in which they were completed. However, some candidates were unable to make the connection between $\text{cosec}^2 y$ and $\cot y$. Part (*b*) was very well answered. Part (*c*) was also well answered, although some candidates were unable to see the connection between parts (*b*) and (*c*); some began again, with all marks available to them, whilst other candidates integrated part (*b*), losing the M1A1 marks at the beginning. In part (*c*), many candidates did not write the logarithmic term with modulus signs and, whilst they were not penalised this time, it often led to an incorrect statement in part (*d*). Few candidates were able to spot that the integrand was undefined at $x = -1 \cdot 5$, focusing more often on the fact that substituting $x = -1 \cdot 5$ would lead to a negative value inside the logarithm.

Q.5 In part (*a*), many candidates were able to use the factor formula; however, not all candidates were able to express $\sin(-\theta)$ as $-\sin\theta$. Part (*b*) was answered well, with the majority of candidates gaining full marks, benefitting from the permitted follow through from part (*a*), where appropriate.

Q.6 This question proved to be the highlight of this paper, with the vast majority of candidates answering it very well. Some candidates failed to write their final answer as an equation and consequently lost the final A1 mark.

Q.7 In part (*a*), the majority of candidates were able to use the expansion of $\ln(1+x)$ from the Formula Booklet, although some squared $(-x)$ incorrectly for the second term. However, some candidates worked from the Maclaurin expansion of $f(x)$. In part (*b*), many candidates were able to use the rules of logarithms, but few candidates were able to correctly deal with the power of -2, losing accuracy marks. Some candidates again worked with the Maclaurin expansion of $f(x)$, and differentiation errors proved costly on numerous occasions.

Q.8 This question was answered well by many candidates. The first four marks in part (*a*) were usually awarded, as were the final two A2 marks for finding θ and r, particularly because of the follow through allowed from candidates' trigonometric equation. The double angle formulae for $\tan(2\theta)$ and $\cos(2\theta)$ were used in equal measure by candidates. In part (*b*), candidates sometimes struggled to convert to Cartesian coordinates from polar form.

Q.9 In part (*a*), more candidates used Method 2 (implicit differentiation) and this often proved very successful. Those candidates who used Method 1 (chain rule) often omitted the negative sign, leading to an answer of 1 rather than -1. In part (*b*), candidates often omitted the '$\times 4$' in the first term, which led to a loss of two accuracy marks. In part (*c*), candidates again omitted the '-1' when using the chain rule, but benefitted from the permitted follow through for the B1 marks at the end of the question. Disappointingly, some candidates thought $\tanh^{-1}(1-x)$ was equivalent to $\dfrac{1}{\tanh(1-x)}$.

Q.10 This question was answered well on numerous occasions. Those candidates who divided by $\sec x$ often continued to gain full marks, although some encountered difficulties in simplifying $\dfrac{\operatorname{cosec} x}{\sec x}$. Disappointingly, some candidates tried to use $e^{\int \operatorname{cosec} x \, dx}$ as the integrating factor, gaining no marks.

Q.11 Part (*a*) was very well answered, with candidates showing their workings to gain full credit. In part (*b*), candidates often set up the integrand correctly, but encountered difficulties dealing with $\cosh^2(2x)$. Some of these candidates made use of the exponential form and, whilst this was a longer method than intended, it often led to a correct answer. Part (*c*) was very well-answered, with the majority of candidates spotting that it was double their answer to part (*b*); some candidates gave symmetry as a reason and, whilst it was not necessary, it was pleasing to see.

Q.12 Parts (*a*) and (*b*) were answered well by the majority of candidates, with only a few candidates not rounding to three decimal places in part (*a*). In part (*b*), the majority of candidates used Method 2 in the mark scheme, including converting to decimal form. Those candidates who used the full calculator output, reached the correct conclusion. Candidates are reminded that using exact values is to be expected in Further Pure Mathematics papers. In part (*c*), there was an even spread of candidates using each of the three methods in the mark scheme. There was good algebraic manipulation to be seen, with candidates stating each required step to 'convince' the examiner, as the result was given in the question. However, some candidates were unable to deal with squaring the exponential forms of $\cosh x$ and $\sinh x$, with the '$+\frac{1}{2}$' often omitted.

Summary of key points

- Most candidates worked through the paper in question number order. Candidates are reminded that this is not essential and working to their strengths may lead to higher marks.

- Poor algebraic skills were apparent in many questions, particularly when differentiating using the chain rule.

- Problem-solving skills were not always apparent, leading candidates to omitting some parts of questions.

- Not all candidates made good use of the Formula Booklet – candidates are reminded of the assistance provided within the Formula Booklet.

- Most candidates showed all their working; however, all candidates are reminded to show sufficient working for their solutions. Particular attention to detail is required when the candidate is asked to show a given result.