MATHEMATICS

General Certificate of Education (New)

Summer 2022

Advanced

PURE MATHEMATICS B – A2 UNIT 3

General Comments

This paper is of a similar standard to previous years, though there were less marks at the top end and rather more marks at the bottom end. Multiple excellent solutions were seen to all questions. Generally, candidates were let down by inadequate algebraic skills. In many questions, the A level work was successfully completed, but marks were lost in the subsequent work.

Comments on individual questions/sections

Q.1 This question provided a good start to the paper as most candidates obtained full marks. Some candidates did not correctly remember the formula for $\sec^2 x$. Others could not obtain the correct angles from values of $\tan x$.

Q.2 Part (a) was very well done. The only common error occurred when differentiating $\ln(5x)$ – many candidates forgot to use the chain rule. Part (b) was also well done, though many candidates left out the brackets around $1 - 3\sin 3x$.

Q.3 This was a generally well-done question. Some candidates did not know how to find the area of the right-angled triangle, and incorrectly used the formula $\frac{1}{2}r^2\sin\theta$ instead.

Q.4 Almost all candidates managed to gain the first two B1 marks for using the formula for sum to infinity of a geometric progression. The subsequent algebra left much to be desired and too many candidates thought $112\frac{1}{2}$ was the same as 56.

Q.5 A good question for many candidates until the very end. The integration of the third term was often incorrect with candidates ignoring the coefficient of x in the denominator. Many did not know how to halve the given expression and even more could not deal with the unequal coefficient in the third ln term when combining lns. A significant number did not have the constant of integration.

Q.6 Apart from the candidates who thought this was a question on geometric progressions, most candidates did this question well. A significant number of candidates found the sum rather than the 11th term in part (a). A handful of candidates used $d = 20$ rather than $d = 0.2$.

Q.7 Another question which was generally well done by the majority of candidates. Some candidates had difficulty dealing with the $\sqrt{x}$ and obtained the incorrect upper limit for the subsequent integration.

Q.8 Candidates generally know the A level work well. However, a variety of algebraic and arithmetic errors were seen, and candidates had difficulties simplifying the resulting numerical expression into the correct fraction at the end. Some candidates had the incorrect index, commonly $\frac{1}{2}$, rather than the correct $-\frac{1}{2}$. Even $\frac{3}{2}$ was seen several times.

Q.9 This was a very simple question and finding the terms was generally well done by the majority of candidates. Some candidates used their calculators in the incorrect mode and got ridiculous answers for part (a). Others worked forwards rather than backwards in part (b) and found the 6th 7th etc terms in part (b). Types of sequences does not seem to be well understood. In the specification, apart from arithmetic progressions and geometric progressions, candidates should know about periodic, increasing and decreasing sequences.

Q.10 This question proved rather more difficult for candidates than was anticipated. Candidates did not factorise out the common factor x^2. They also ignored the hint in the question that $(3x+2)$ must be a factor of the numerator. Some candidates managed to fully factorise the numerator, but still did not cancel out the common factor, so that they had an extra root, $-\frac{2}{3}$, not realising that this value makes the expression undefined. Candidates who thought to use the factor theorem repeatedly usually did well.

Q.11 Part (a) of this question was reasonably well done. Part (b) was not so well done, with many candidates not realising that to maximise the expression, the required value for $\cos(x - 77)$ was –1. A few did not make the substitution suggested in part (a), making the problem very difficult.

Q.12 Part(a): Most candidates were not able to work out $ff(p) = f(0) = 10$. Some attempted to find an expression for $ff(p)$ in terms of p, which was not helpful.

Part(b): Most candidates were able to gain the two marks available here.

Part(c): A normal complete-the-square problem. However, many candidates had difficulties with the coefficient of x^2 not being 1. Many arithmetic and algebraic errors were seen. Typically, candidates factored out the 2, successfully completed the square and forgot to multiply the constant by 2 when removing brackets.

Part(d): Reasonably well done.

Part(e): The majority of candidates lost the mark for taking square root as they only displayed the positive root without explanation as to why the negative root was not included. In the sketch for g^{-1}, many candidates were penalised for displaying 'extra bits' which did not belong to g^{-1}.

Q.13 Part(a) was very well done by many candidates. Some tried solving the equation $f'(x) = 0$ and said all roots were imaginary, some found the discriminant to be negative and said there were no real roots, but hardly any notice that $6x^2 + 3$ must be positive for all values of x.

Part (b) was generally well done.

In part (c), some very strange sketches were seen.

Q.14 Most candidates started off well, with the first step in this question on integration by parts. However, many did not use integration by parts again in the resulting integral. With those who successful used integration by parts twice, many sign errors were made as they did not 'tidy up' their signs leaving lots of minuses about. The coefficient of 2 in the third term was often lost. Candidates obviously checked their answers using the calculator as, quite often, the correct answer 5.87 appeared in the final line unsupported by correct working further up the solution.

Q.15 The majority of candidates had difficulty finding an expression in terms of x for the area of the rectangle. They were not able to find y in terms of x, as they did not make use of the right-angled triangle with the hypothenuse as the radius of the circle, or remember the equation of a circle centred at the origin with a given radius. For the few candidates who had the correct expression for A in terms of x, most realised that the expression had to be maximised with respect to x. It is a great deal easier to maximise A^2, but no candidate spotted that short cut. One candidate did manage to maximise the expression by taking the x into the square root thus obtaining a quadratic expression in x^2 which could be maximised by completing the square.

Q.16 Surprisingly, many candidates did not realise that 'meeting the y-axis' meant $x = 0$. Instead, they found $\frac{dx}{dt}$, $\frac{dy}{dt}$ and hence $\frac{dy}{dx}$ which was only relevant in part (b). In part (b), all that was required was $\frac{dy}{dt} = 0$ (if $\frac{dy}{dt} = 0$, $\frac{dy}{dx}$ will also be 0), and $y = 0$ occured at the same value of t. Most candidates however, used $\frac{dy}{dx} = 0$ instead, which was also correct, though a longer method. Some managed to find t when $\frac{dy}{dx} = 0$, but did not complete the solution by showing that y is also 0 at this value of t.

Q.17 Most candidates managed to expand $\cos(\alpha - \beta)$ and $\sin(\alpha + \beta)$ correctly, but were then unable to factorise the expanded form into the required form. They did not think to expand the right-hand side to give the expanded form to show that the two are equal.

Part (b)(i) required candidates to substitute $\alpha = 4\theta$ and $\beta = \theta$ into the identity in part (a).

Part (b)(ii) hangs on the fact that the denominator is 0 when $\theta = \frac{3\pi}{4}$. Both of these proved difficult for many candidates.

Q.18 It was pleasing to see the correct substitution spotted by many. Sadly, candidates were then unable to deal with the simple bit of algebra required to write the expression into an integrable form. Either $(u - 3)^2 = u^2 - 9$, or $\frac{u^2-6u+9}{u^4} = \frac{-6u+9}{u^2}$, was often seen. Those that managed it, usually did very well on this question.