MATHEMATICS

General Certificate of Education (New)

Summer 2019

Advanced Subsidiary/Advanced

PURE MATHEMATICS B – A2 UNIT 3

General Comments

This paper seems to be broadly comparable to last year's paper on this reformed specification. This is the first year where there is a full cohort so that, predominantly, it is being sat by 18-year olds and not 17-year olds. Candidates appeared to be reasonably well prepared. Numerous good solutions to all the questions were seen, indicating that all of the questions on the paper were accessible to the candidates. However, there were a few marks which were only gained by the best candidates. The questions involving more than one topic, or the necessity to translate the requirements of the questions into mathematics, were less well done.

Comments on individual questions/sections

Q.1 This was a well-done question. Pleasingly, there were very few candidates who started with the incorrect form of the partial fractions. Most of the errors were algebraic or careless ones. In part (*b*), almost all the candidates realised that the partial fractions form should be integrated, although there were some errors in integrating $\frac{3}{(x+2)^2}$, and some candidates forgot the constant of integration which lost them a mark.

Q.2 The binomial expansion is well understood and the formula was effectively applied. Many candidates tried to expand $(4-x)^1$ using the binomial formula and strangely did not always arrive at $(4-x)$, but made the problem much more difficult by arriving at the first four terms of a series.

Q.3 Part (*a*) was well done, though not invariably so. In part (*b*), many candidates assumed that if the sequence was not an arithmetic progression, then it must be a geometric progression and vice versa. Even more were not able to succinctly explain the reasons why the series was neither an arithmetic progression nor a geometric progression, so many erroneous statements, as well as many that did not make any sense, were seen.

Q.4 This question was on a topic that was in the legacy specification and, as such, was well done generally. Part (*b*) was less well done than the other two parts as some candidates went back to the original expression, so that finding the maximum denominator was not trivial. A variety of wrong methods were seen.

Q.5 In part (*a*), many candidates were able to correctly write down the two algebraic inequalities equivalent to the modulus inequality. However, in solving these inequalities, a very common error was to forget to reverse the inequality when multiplying throughout by a negative number.

In part (*b*), candidates were generally able to draw a V shape graph with the minimum below the x-axis. However, many candidates did not obtain the correct minimum point.

Q.6 In part (*a*), most of the error was in evaluating the trigonometric functions at $\frac{\pi}{4}$.

Some candidates did not simplify these expressions before using them to find the equation of the tangent which made the equation extremely complicated and careless mistakes were numerous.

Inexplicably in part (*b*), many candidates tried to find the point of intersection between the given line and the tangent found in part (*a*). This was not what was required by the question.

Q.7 Some very carelessly drawn graphs were seen, but, on the whole, this question did not cause problems for the candidates, though the transformed graphs often did not look much like the original version.

Q.8 Part (*a*) required knowledge of both arithmetic progression and geometric progression to be applied and many candidates found this very confusing. For those who managed to apply their knowledge of both types of series, often the resulting equations were not the most efficient ones so that the algebra turned out to be more complicated than it needed to be.

Candidates mostly did recognise that they were dealing with an arithmetic progression in part (*b*). Those who did not and tried to answer the question by pure reasoning often made the mistake of increasing the numbers from day 1 instead of day 2, getting the answer 580, instead of the correct 568. Disappointingly, many who had the correct series, were not able to use it to answer (ii) correctly.

Q.9 Part (*a*) was a simple trigonometric identity. The proof required $\tan(\alpha+\beta)$ to be expanded and the given condition manipulated to get $\tan\alpha\tan\beta = 2$. However, this was not well done, with candidates going around in circles.

In contrast, part (*b*) was a standard trigonometric equation and was done well.

Q.10 The product, quotient and chain rules for differentiation are well known, as is implicit differentiation. However, candidates made many careless errors in their application. In particular, essential brackets were often omitted making the answers incorrect. This was particularly marked in (*a*)(iii) where candidates applied the chain rule correctly, but omitted the bracket round $\left(\sec^2 x + 7\right)$. Many marks were lost unnecessarily in this question.

Q.11 Most candidates did have the correct approach. However, the simple bit of algebra required to do this question successfully did cause great difficulties to the candidates. As did the sketching of the required graphs. Not many correct graphs were seen.

Very few candidates got the correct range for $f(x)$, and so the mark for the domain of $f^{-1}(x)$ was lost. This also led to the loss of the mark in part (*b*). Owing to the lack of the correct graphs in part (*a*), part (*b*) was very badly done.

Q.12 Part (*a*) can be very simply done by equating the area of the minor segment to $\frac{1}{3}$ of the area of the circle. Many candidates obtained the area of the minor segment and did not know how to proceed thereafter, or chose the more difficult route of involving the major segment, making lots of algebraic errors on the way.

Part (*b*)(i) was well done generally. Candidates who knew the Newton-Raphson iterative formula, or remembered to look it up in the Formula Booklet, did this question well. There were a few candidates who gave an incorrect form, or used an incorrect $f(x)$, often leaving out a term.

Q.13 This question was surprisingly well done. The last two marks were often lost by incorrect inversion of $\ln$ to get an expression for A in terms of e. There were also some errors with combining the two $\ln$ terms which appeared after the use of the first set of conditions.

Q.14 This question on integration was reasonably well done. The methods for integration were well known to the candidates. Part (*b*) caused some difficulties as candidates did not spot that the answer can be just be written down. In part (*d*), some candidates did not like integrating from 3 to 2 and reversed the order thus obtaining a negative answer.

Q.15 This was bookwork; a proof that needed to be learnt. The responses revealed that candidates did not pay sufficient attention to the details of the proof. In particular, after assuming that $\sqrt{6} = \frac{a}{b}$, the fact that a and b have no common factors was often omitted. Nevertheless, candidates, after showing that a and b did have a common factor, went on to conclude that this was a contradiction.

Summary of key points

Many marks are unnecessarily lost due to careless algebraic manipulation, and carelessness when applying standard techniques. The omission of important brackets is also widespread.

More care is needed in the sketching of graphs, especially in questions where graphs are being transformed. The transformed graph needs to bear some relationship to the original version. Points need to be clearly labelled and attention paid to the position of asymptotes, that they are not being crossed by the graphs.

Many errors result from candidates not remembering the important formulae accurately. For example, $\cos 2\theta$ was often expanded to $2\sin^2\theta - 1$. This kind of error often makes the question more difficult to solve, losing many accuracy marks, though follow through marks are awarded.

As expected, problem-solving questions were less well done generally.