GCE EXAMINERS' REPORTS

MATHEMATICS (C1 - C4 and FP1 - FP3) AS/Advanced

SUMMER 2013

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MATHEMATICS

General Certificate of Education

Summer 2013

Advanced Subsidiary/Advanced

Principal Examiner: Dr E Read

C1

General Comments

This turned out to be a slightly easier paper that last year's. The majority of the questions were well answered; it was only questions 3(*b*), 5(*b*), 6(*a*)(ii) and in particular question 10 which caused any problems.

Individual questions

Q.1 This question was well answered, as is always the case, with many candidates getting full marks.

Q.2 Another generally well answered question, but at the end of part (*a*), surprisingly many candidates made sign errors in writing down the final answer while in part (*b*), not all were able to simplify $\frac{\sqrt{30} \times \sqrt{8}}{\sqrt{6}}$ correctly.

Q.3 Part (*a*) caused few problems but in part (*b*), many candidates did not realise that the fact that the tangent was parallel to the *x*-axis at *Q* meant that

$$\frac{dy}{dx} = 0 \text{ at } Q.$$

Q.4 Although most candidates were able to answer part (*a*) correctly, a common error in part (*b*) was to give the value of *x* corresponding to the least value of the expression as 2 rather than 4.

Q.5 Most of the errors which occurred in this question were arithmetic errors but some candidates also got some of the powers wrong. Not all candidates realised that all they had to do in part (*b*) was to multiply their answer to part (*a*) by $1 - 4x$ and then collect terms.

Q.6 Part (*a*)(i) was well answered but the fact that a second discriminant had to evaluated in part (*a*)(ii) caused problems for some candidates. Some stated that they could not factorise $4k^2 + 8k + 7 = 0$ and thus no real solutions could exist. Solutions of the quadratic inequality in part (*b*) continue to be disappointing.

Q.7 In part (*a*), differentiation from first principles was generally good but incorrect or inconsistent notation led to some candidates losing the final mark.

Q.8 Not all candidates realised that they the first step to solving this question involved the use of the factor theorem and some started off by differentiating the equation. Later on in the question, a minority were unable to factorise $8x^2 - 10x + 3$ correctly.

Q.9 As is usually the case, candidates had few problems with this question.

Q.10 In part (*a*)(i), some candidates were unable to write down a correct expression for the surface area of the box and then carry out the required algebraic manipulation to derive the given expression for xy. In part (*a*)(ii), candidates did not always explain how they arrived at the printed answer for the volume V. Those candidates who realised that they had to differentiate in part (*b*) were usually able to earn the majority of the marks although some forgot to find the actual maximum value of V.

MATHEMATICS

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Principal Examiner: Dr E Read

C2

General Comments

This year's paper turned out to be to be a more accessible paper than the corresponding C2 paper last year. There was no single question which was very poorly answered but many candidates lost marks on questions 2(*a*)(i), 3(*a*), 7(*a*), and 7(*c*). There was evidence of candidates' poor algebraic skills and sometimes of the poor quality of candidates' written communication.

Individual questions

Q.1 The majority of candidates obtained full marks on the Trapezium Rule question and there were very few incorrect solutions.

Q.2 In part (*a*)(i), not all candidates were able to rewrite the given equation in the required form.. Part (*a*)(ii) caused few problems as is usually the case. In part (*b*), some candidates lost marks by transposing and dividing incorrectly while others neglected the value of $-38°$ for $2x - 60°$ which leads to a final answer of $x = 11°$.

Q.3 Much of the work seen in part (*a*) was disappointing. Brackets were omitted, often with disastrous consequences, and algebraic manipulation was generally poor. In part (*b*), some candidates put the given expression in x equal to 120 rather than to $\cos 120° = -{}^1/_2$.

Q.4 There were few problems in part (*a*) although some candidates are still unable to furnish a correct proof of the formula for the sum of the first n terms of an A.P. In part (*b*), only a minority of candidates decided to answer the question by first of all using the given information to show that $S_{14} = 245$.

Q.5 Parts (*a*) and (*b*)(i) were both well answered. The reasons given for the correct choice of r in part (*b*)(ii) were many and varied and often poorly expressed.

Q.6 Some candidates came unstuck in part (*b*) because they thought that they in some way had to subtract areas. Those who realised that the required area was the sum of the area of a triangle and the area under a curve were usually able to get the correct answer.

Q.7 Some of the attempts at proof in part (*a*) were poor. Part (*b*) was well answered but in part (*c*), many candidates thought that ${}^1/_2 \log_a 144x^8$ was either equal to $\log_a 12x^8$ or, more often, to $\log_a 144x^4$. Some of the algebraic manipulation involved here was also disappointing.

Q.8 Generally well answered but not all candidates appreciated that all they had to do in part (*b*)(i) was to show that *A* did not lie on *L*. Many of those who seemed to be going down this road were unable to explain clearly what they were trying to do.

Q.9 Many candidates got full marks on this question but there were still many examples of incorrect arithmetic computation and poor algebra.

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C3

General Comments

Candidates found this year's paper to be more accessible than last year's corresponding paper. The majority of the questions were well answered; and apart from some poor algebra in question 10(*a*), it was only questions 2(*b*), 3(*b*)(ii), 11 and in particular question 7 which caused any real problems.

Individual questions

Q.1 Part (*a*) was universally well answered. Many candidates, however, gave their answer to part (*b*) as being the square root of 5·328 rather than half of it.

Q.2 There were no problems in part (*a*). Many candidates, however, were unable to make any progress in part (*b*), a common error being the substitution of sec $\phi - 1$ for tan ϕ..

Q.3 Most candidates were able to pick up the first five marks. In part(*b*)(ii), however, only a minority of candidates realised in order to find the values of *a* and *b*, that they had to substitute back into the original equation given in the question.

Q.4 Generally well answered, the most common error being in part (*a*) where a significant number of candidates thought that $20t^3 \div (1/t) = 20t^2$.

Q.5 Many candidates got full marks on this question. It was only the final simplification in part (*d*) which caused any real problems.

Q.6 The integration question is always very well answered and this year was no exception.

Q.7 There were many poor attempts at solution to part(*a*). Many candidates had little idea of what was required while others seem to think that proof by counterexample is somehow intrinsically linked with trigonometry and it was not uncommon to see suggested values of $a = 30$, $b = 60$. In part (*b*), the majority were able to show that $4 \le x^2 \le 16$ but very few were then able to proceed to a complete final answer of: $2 \le x \le 4$ or $-4 \le x \le -2$.

Q.8 Most candidates got full marks on this question.

Q.9 The majority of candidates found this to be a straightforward question and earned all three marks.

Q.10 This was generally well answered but some candidates lost marks because of poor algebraic manipulation.

Q.11 Not all candidates were able to find the range of *fg* in part(*a*)(ii). Many candidates did solve the equation in part (*b*)(i) but only a minority were then able to earn the final mark in part (*b*)(ii). The reasons for the choice of *k* given here were many and varied and to a large extent incorrect.

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C4

General Comments

Candidates found this to be a more difficult paper and less accessible than most C4 papers of recent years. The questions which caused most problems were questions 4 and 9 and to a lesser extent, questions 6(*c*), 7(*b*) and 10.

Individual questions

Q.1 Part (*a*) was well answered but in part (*b*), it was sometimes unclear whether candidates were integrating or just differentiating incorrectly.

Q.2 Well answered, as is always the case.

Q.3 Almost all candidates were able to pick up the majority of the marks in part (*a*). In part(*b*), some candidates expanded $\cos(\theta + \alpha)$ incorrectly and then either ignored a minus sign or ended up with a negative value for α. Nevertheless, it was not uncommon to find candidates being awarded full marks for this question.

Q.4 Candidates who did not realise that in order to carry out the required integration, they had to express $\sin^2 2x$ in terms of $\cos 4x$ were unable to make much progress on this question. Those who did this correctly usually ended up with full marks.

Q.5 Most candidates used the binomial theorem correctly. In part (*b*), some were happy to give two possible roots for the equation, ignoring the fact that they had already noted that the expansion was only valid when $-{}^1/_6 < x < {}^1/_6$.

Q.6 In part (*a*), the majority of candidates were able to derive the equation of the tangent in the given form but fewer were then able to proceed in part (*b*) to find the area of the triangle *AOB*. Part (*c*) was disappointing. Many of those who actually managed to derive the quadratic equation $p^2 - 2p + 2 = 0$ then stated that they could not factorise it and thus no real solutions existed.

Q.7 Part (*a*) was well answered but in part (*b*) many candidates, having correctly rewritten the integrand in terms of u, then made a total mess of the actual integration.

Q.8 Many candidates were able to work through to the penultimate line of this question but disappointingly few were then able to move on from $\sqrt{A} = 2{\cdot}4t + 0{\cdot}8$ to write down a correct expression for A in terms of t.

Q.9 This was a disappointing question. Almost all candidates were able to write down the vector **AB** in part (*a*). In part (*b*), some candidates used a first principles method while others used the formula for the position vector of a point dividing a line in a given ratio but some quoted the formula incorrectly. Part (*c*)(i) showed that many candidates do not understand what information is given to them in each of the two parts of the vector equation of a line. In part (*c*)(ii), very few candidates actually verified that *B* was on *L* by finding the value of λ which gave the position vector of *B* while others did not realise they had to show that *AB* was perpendicular to *L*.

Q.10 Although performance on the proof by contradiction question has recently improved, there seemed to be a backward step this year. Most of the errors which were made appeared as a result of poor algebraic manipulation.

MATHEMATICS

General Certificate of Education

Summer 2013

Advanced Subsidiary/Advanced

Principal Examiner: Dr J Reynolds

FP1

General Comments

The candidature was generally good with some excellent scripts seen. Solutions to the question on induction continue to be poorly presented by many candidates. The question on logarithmic differentiation was not well answered in general, probably due the fact that it was somewhat different from previous questions on that topic.

Comments on Individual Questions

Q.1 This question was, surprisingly, one of the worst answered questions on the paper. A common error was to write

$$\sum_{r=1}^{n}(2r-1)^2 = 4\sum_{r=1}^{n}r^2 - 4\sum_{r=1}^{n}r + 1$$

not realising the that the Σ operates on the 1 term. Algebraic errors were often seen and some candidates even ended, incorrectly, by writing

$$S_n = \frac{4}{3}n^3 - \frac{1}{3}n = 4n^3 - n$$

thinking, perhaps, that *a* and *b*, required to be rational, meant that they had to be integers.

Q.2 This question was well answered in general with most marks being lost due to careless algebraic errors.

Q.3 This question was well answered in general. Candidates who were unable to show that $\frac{\beta\gamma}{\alpha} + \frac{\gamma\alpha}{\beta} + \frac{\alpha\beta}{\gamma} = -8$ in (a) were often able to find the values of the required sums and products in (b) and complete the question successfully.

Q.4 Most candidates solved (a) correctly but solutions to (b) were sometimes unconvincing. Many candidates showed that the coordinates x,y of a fixed point would satisfy the equations $x = x + 1$ and $y = -y + 2$. Candidates were then expected to state there were no fixed points because the first equation had no solutions or that the equations were not consistent. Some candidates deduced that 0 = 1 therefore no fixed points and this was accepted although not completely convincing. Candidates who stated simply ‘therefore no fixed points’ were not awarded the final A1.

Q.5 The presentation of solutions using mathematical induction continues to be poor. The following sentences are taken from last year's report but they still apply. Having established that the result is true for $n = 1$, the proof should start with a statement such as 'Assume that the result is true for $n = k$'. Instead of this, many candidates just write 'Let $n = k$' or even '$n = k$'. The next line should then state something like 'Consider, for $n = k + 1$' followed by the appropriate algebra. Many candidates just write 'Let $n = k + 1$'. Candidates should then round off the proof with something along the lines of 'Assuming the result to be true for $n = k$ implies that the result is true for $n = k + 1$ and since we have shown it to be true for $n =1$, the general result follows by induction'. Many candidates finish with an incorrect statement such as 'Therefore true for 1,k and $k + 1$ so proved by induction'.

Q.6 This was the best answered question on the paper and the processes of row reduction and the determination of inverse matrices is well understood by most candidates.

Q.7 This was the worst answered question on the paper, probably due to the fact that it was different from the usual questions on logarithmic differentiation. Candidates should be aware that logarithmic differentiation is often an efficient method of finding the derivative of a product or quotient where the terms are themselves fairly complicated.

Q.8 Part (a) was a fairly standard question which was well answered by most candidates. In (b), however, some candidates found the problem of eliminating either x or y to find the relationship between u and v beyond them.

MATHEMATICS

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Advanced Subsidiary/Advanced

Principal Examiner: Dr J Reynolds

FP2

General Comments

The standard of the scripts was generally good although solutions to Q5 were often disappointing.

Comments on Individual Questions

Q.1 This was the best answered question on the paper with most candidates solving it correctly.

Q.2 This question was well answered by most candidates. The only errors, seen occasionally, were an incorrect solution to the quadratic equation and incorrect $\tan^{-1}$ values given.

Q.3 Some candidates were unable to express – 1 as a complex number in trigonometric form which made (a) inaccessible although their roots were followed through in (b) where possible.

Q.4 Most candidates showed correctly that

$$f'(x) = -\frac{5}{(x-1)^2}$$

but some candidates lost a mark by simply stating 'therefore *f* is strictly decreasing' without stating that this was because f' is negative for all *x*. Some candidates rewrote *f*(*x*) as

$$f(x) = 2 + \frac{5}{x-1}$$

and stated that *f* is decreasing because the second term is clearly decreasing and this was, of course, accepted. Some candidates evaluated *f*(*x*) for two different values of *x*, eg *f*(2) = 7 and *f*(3) = 4.5, therefore *f* is decreasing but this, of course, was not accepted.

Q.5 This was the worst answered question on the paper. It was disappointing to see that some candidates were unable to complete the square correctly in (a)(i). In (a)(iii) and (a)(iv), some candidates forgot to apply the appropriate translation to take account of the fact that the ellipse was not centred at the origin. Solutions to (b)(i) were sometimes disappointing with candidates failing to realise that putting $x = 0$ gave a quadratic equation in y that had a repeated root which indicated that the y-axis was a tangent. In (b)(ii), candidates who considered the intersection of the line $y = mx$ with the ellipse, making the two points coincident, were usually successful. Those who tried to find the equation of the tangent at a general point on the ellipse, then making it pass through the origin, were almost always unsuccessful.

Q.6 Part (a) was well answered by most candidates. In (b), however, some candidates tried to integrate $\frac{x-2}{x^2+3}$ as a single term which often indicated a poor understanding of integration.

Q.7 This question was well answered in general. In (b), candidates who rewrote $f(x)$ as

$$f(x) = 4x + \frac{4}{x} + \frac{1}{x^3}$$

were generally more successful in the differentiation than those who left $f(x)$ in its original form. In (c), the oblique asymptote was sometimes missed although the candidates should have been aware of its existence since the wording of the question implied that there was more than one asymptote.

Q.8 This question was well answered in general. The expected method was to use the result $(\cos\theta + i\sin\theta)^5 = \cos5\theta + i\sin5\theta$ and to equate real terms and most candidates did that successfully. Some candidates, however, expanded $\left(z + \frac{1}{z}\right)^5$ and obtained an expression for $\cos^5\theta$ in terms of $\cos\theta$, $\cos3\theta$ and $\cos5\theta$ but most then rescued the situation by using the standard formula for $\cos3\theta$ in terms of $\cos\theta$.

MATHEMATICS

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Principal Examiner: Dr J Reynolds

FP3

General Comments

The standard of the scripts was generally good with some excellent scripts. However, solutions to Q4 were extremely disappointing with most candidates unable to integrate a function that is mentioned in the specification. Some candidates also seemed to be unfamiliar with the condition for convergence of the iterative method based on the equation $x = F(x)$.

Comments on Individual Questions

Q.1 This was the best answered question on the paper. It was noted, however, that some candidates evaluated $\cosh^{-1} 2$ and $\cosh^{-1}(1.5)$ by first converting to logarithmic form. This is, of course, acceptable but the extra step increases the risk of error. Candidates should be encouraged to use the $\cosh^{-1}$ button on their calculators.

Q.2 Part (a) was well answered in general but solutions to (b) were often disappointing. Most candidates knew that they had to differentiate something and then show that a modulus was less than 1 but some chose the wrong function, often $\frac{a}{x^2} - x$.

Candidates who did the correct differentiation, obtaining $-\frac{2a}{x^3}$, then put $a = 10$ and $x = 2.1544\ldots$ This was not accepted since the question asked for the result to be shown for all positive a.

Q.3 This question was well answered in general.

Q.4 Solutions to this question were extremely poor with a mean mark of 3 out of 10. Many candidates were unable to carry out the necessary completion of the square with some even taking the minus sign outside the square root to make it easier. Some of the candidates who completed the square correctly then used a hyperbolic substitution which led nowhere. Some candidates thought that the function could be integrated immediately to $\frac{(3+2x-x^2)^{3/2}}{\frac{3}{2}(2-2x)}$.

Completely correct solutions were rarely seen.

Q.5 This question was well answered in general.

Q.6 In (a), most candidates knew they had to maximise $x = r\cos\theta = \sin^2\theta\cos\theta$ but some then expressed $\sin^2\theta$ in terms of $\cos 2\theta$ which usually meant that they were unable to complete the question. This is a necessary transformation in integration and it had to be used in (b) but it is not usually recommended when differentiating. Most candidates who reached the equation $2\sin\theta\cos^2\theta - \sin^3\theta = 0$ failed to see that this led immediately to $\tan^2\theta = 2$ and some quite long but eventually successful solutions were seen. Part (b) was generally well done.

Q.7 This question was well answered in general and many candidates followed the instructions in (a)(i), (a)(ii), (b)(i) and (b)(ii) successfully. It was noted, however, that many candidates were unable to carry out correctly the numerical computation required in (b)(iii).

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