WJEC CBAC

GCE EXAMINERS' REPORTS

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

SUMMER 2012

Statistical Information

The Examiner's Report may refer in general terms to statistical outcomes. Statistical information on candidates' performances in all examination components (whether internally or externally assessed) is provided when results are issued.

Annual Statistical Report

The annual Statistical Report (issued in the second half of the Autumn Term) gives overall outcomes of all examinations administered by WJEC.

MATHEMATICS

General Certificate of Education

Summer 2012

Advanced Subsidiary/Advanced

Principal Examiner: Dr. E. Read

Unit Statistics

The following statistics include all candidates entered for the unit, whether or not they 'cashed in' for an award. The attention of centres is drawn to the fact that the statistics listed should be viewed strictly within the context of this unit and that differences will undoubtedly occur between one year and the next and also between subjects in the same year.

Unit	Entry	Max Mark	Mean Mark
C1	3299	75	47.4

Grade Ranges

A	63
B	55
C	47
D	39
E	32

N.B. The marks given above are raw marks and not uniform marks.

C1

General Comments

Candidates found this year's paper to be more accessible than the corresponding papers of recent years. The majority of the questions were well answered; it was only questions 1 (d) (iii), 6 (b) and parts of question 10 which caused any problems.

Individual Questions

Q.1 It was only the very last part of this question which caused any real difficulty. Not all candidates realised ADC was a right angled triangle while others were unable to manipulate the surds correctly.

Q.2 Generally well answered, but in part (b), many candidates were unable to simplify $\frac{5\sqrt{63}}{\sqrt{7}}$

Q.3 Part (a) was well answered, as is always the case. Part (b) seemed to cause fewer problems than has been the case with similar questions in recent years.

Q.4 A straightforward binomial question. Most of the errors which occurred were sign errors.

Q.5 Although most candidates were able to answer part (a) correctly, many were then unable to use their answer to find the required stationary value of the given expression.

Q.6 Although the format of the discriminant question was slightly different this year, algebraic manipulation was generally good and many candidates were able to get full marks on part (a). Solutions of the quadratic inequality in part (b), however, were disappointing, as was the case last year.

Q.7 Differentiation from first principles continues to improve but some candidates still lose the final mark due to a mathematically incorrect statement.

Q.8 Almost all candidates are able to use the factor theorem to solve cubic equations on this paper. Most candidates were also able to get the correct answer for part (b), even though this particular application of the remainder theorem has not been examined in recent years.

Q.9 Candidates had few problems with this question.

Q.10 In part (a), some candidates were unable to deal with the absence of a constant term in the quadratic equation whose roots are the x-coordinates of the stationary points. In part (b), most, but not all candidates realised that their graph had to be that of a positive cubic, while in the final part, some candidates tried to use the quadratic formula to find the number of positive real roots of the given cubic equation.

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Unit	Entry	Max Mark	Mean Mark
C2	4652	75	41.3

Grade Ranges

A	58
B	50
C	42
D	35
E	28

N.B. The marks given above are raw marks and not uniform marks.

C2

General Comments

Candidates probably found this year's paper to be less accessible than the corresponding paper last year. There was no single question which was generally very poorly answered but many candidates lost marks on questions 2 (c), 3 (b), 5 (b), 8 (b) and to some extent, question 9.

Individual Questions

Q.1 The question on the Trapezium Rule was well answered, as is always the case.

Q.2 Part (a) caused few problems but in part (b), some candidates lost marks by transposing and dividing incorrectly. Most candidates realised that part (c) probably involved rewriting the equation in terms of $\tan\phi$ but again poor algebra led to incorrect solutions.

Q.3 In part (a), some candidates took the angle BAC itself rather than $\cos B\hat{A}C$ to be $\frac{2}{5}$
In part (b), we did not always see a diagram and not all candidates realised that there were two possible values for each of the angles XZY and YXZ.

Q.4 There were few problems in parts (a) and (b), but in part (c), many candidates did not simplify their expression correctly and consequently lost the final mark.

Q.5. Whereas most candidates earned the first two marks in part (a) by writing down two correct expressions involving a and r, only a minority were then able to proceed to eliminate a and derive the given quadratic in r. In part (b), the solution of this equation and the subsequent calculation of the sum to infinity were by no means universally well done.

Q.6. Generally well answered although in part (b), not all candidates realised that a triangle formed part of the required area. Others seemed quite happy to proceed with the x-coordinate of A as -9.

Q.7 As is always the case, some of the proofs in part (a) were at best unconvincing. Part (b) was generally well answered but in part (c), after correctly applying the rules of logarithms, some candidates were then unable to solve for x by correctly remove the logs on both sides of the equation.

Q.8 Part (a) caused no problems, but only a minority of candidates realised that the way to find the length of the tangent in part (b) was to use the fact that the angle between a tangent and a chord is a right angle and then apply Pythagoras' Theorem.

Q.9 Many candidates got full marks on this question but others thought that the shaded area was simply $\frac{1}{2} r^2\theta$.

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Unit	Entry	Max Mark	Mean Mark
C3	1771	75	50.1

Grade Ranges

A	59
B	51
C	43
D	35
E	27

N.B. The marks given above are raw marks and not uniform marks.

C3

General Comments

This turned out to be a slightly easier paper that last year's. The majority of candidates found almost all questions to be accessible but the algebraic manipulation in questions 9 and 10 was sometimes poor.

Individual Questions

Q.1 Part (a) caused very few problems. The answers given to part (b) were many and varied and to a large extent, incorrect.

Q.2 In order to find a counter-example in part (a), candidates had to choose either $\phi = 360 - \theta$ or $\phi = -\theta$. Some candidates did not seem to understand what was required and chose two angles whose cosines were different and whose sines were different. Part (b) was very well answered, as is usually the case.

Q.3 Part (a) caused very few problems, but in part (b), many candidates were unsure of how to deal with the constant a. It was also disappointing to note that only a small minority were able to gain full marks by fully simplifying their expression at the end of (b) (ii).

Q.4 Generally well answered.

Q.5 Very few problems arose here although in part (b), not all candidates were able to differentiate $e^{\tan x}$ correctly.

Q.6 All of part (a) was well answered and in part (b), most candidates were able to make a fair attempt at finding the value of the limit of integration a.

Q.7 In both parts, but particularly in part (a), it was not uncommon to see incorrect manipulation of the modulus signs. Another common error in part (a) was to show that $x = {}^{11}/_{3}$ was a solution and then give the final answer as $x = \pm\, {}^{11}/_{3}$.

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

Q.9 In (a) (i), the majority of candidates were able to differentiate f (x) correctly but not all were then able to give a convincing reason as to why this derivative was always negative. In (a) (ii), many candidates thought that the range of f was (0·6, ∞) rather than (0·6, 1). Much of the algebra in (b) (i) was poor.

Q.10 Most of the errors which occurred here occurred when candidates tried to derive a simplified expression for gg(x). Those who managed to surmount this hurdle were then usually able to earn full marks although some candidates lost the final mark because they forgot to consider the negative root.

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Unit	**Entry**	**Max Mark**	**Mean Mark**
C4	2991	75	51.5

Grade Ranges

A	64
B	56
C	49
D	42
E	35

N.B. The marks given above are raw marks and not uniform marks.

C4

General Comments

Candidates found this to be a fairly straightforward paper and more accessible than last year's paper. The only question which caused any real difficulty was question 6(b).

Individual Questions

Q.1 Part (a) was well answered but in part (b), some candidates made errors when differentiating while others integrated the individual expressions.

Q.2 Universally well answered.

Q.3 It was only (b) (iii) which caused any real problems here. Some candidates argued that since the maximum value of both sin and cos was 1, the greatest possible value for k would be 23.

Q.4. Not all candidates were able to derive a correct expression for y^2 in terms of x. Those who did usually ended up with full marks.

Q.5 Most candidates used the binomial theorem correctly but not all were then able to carry out the required arithmetic manipulation to get the final result. Only a minority stated the correct range of values of x for which the expansion was valid.

Q.6 The vast majority of candidates were able to derive the equation of the normal in the given form. In part (b), the solution of the cubic equation was generally poor, in particular when compared with candidates' solutions to similar equations which appear on the C1 paper. It was also disconcerting to see so many candidates use the following method of solution:

$$p^3 – 7p – 6 = 0 \Rightarrow p^3 – 7p = 6 \Rightarrow p(p^2 – 7) = 6$$

$$\text{Thus either } p = 6 \text{ or } p^2 – 7 = 6 \Rightarrow p = \pm \sqrt{13}$$

Q.7 Part (a) caused few problems but part (b) was a little disappointing in that many candidates failed to express the integrand in terms of u.

Q.8 This was a generally well answered question but in part (b), only a minority of candidates were able to derive the expression for V^2 in the required form.

Q.9 Candidates are now very good at answering vector questions and this turned out to be one of the best answered questions on the paper.

Q.10 Many candidates still find proof by contradiction difficult and although performance has generally improved, there were still many who were unable to give a correct proof that 5 was a factor of b.

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Unit	Entry	Max Mark	Mean Mark
FP1	238	75	50.9

Grade Ranges

A	63
B	55
C	47
D	39
E	32

N.B. The marks given above are raw marks and not uniform marks.

FP1

General Comments

The candidature was extremely variable with some candidates out of their depth at this level but also many candidates submitting excellent scripts. Solutions to the question on induction continue to be poorly presented by many candidates.

Individual Questions

Q.1 This question was well answered by most candidates. Some candidates expanded their initial result, correctly, into

$$\frac{n^4 + 2n^3 - n^2 - 2n}{4}$$

but were then unable to factorise this as required.

Q.2 Solutions to this question were generally good, although some candidates were unable to obtain the correct argument of z. It is important for candidates to realise that it is not true in general that if z = x + iy, then arg(z) = $\tan^{-1}\left(\frac{y}{x}\right)$. The correct result is that arg(z) is an angle whose tan is equal to $\left(\frac{y}{x}\right)$ but is located in the quadrant determined by the signs of x and y. In this question the correct procedure is to use the calculator to find $\tan^{-1}\left(-\frac{11}{2}\right)$ giving – 1.39 and then adding π to give 1.75 (or the degree equivalent).

Q.3 This question was well answered in general although some candidates were unable to express $\alpha^3 + \beta^3$ as $(\alpha+\beta)^3 - 3\alpha\beta(\alpha+\beta)$.

Q.4 Most candidates were able to determine the inverse matrix via the adjugate matrix although some candidates confused the adjugate matrix with the cofactor matrix and the matrix of minors. Some candidates solved the equation using a method not requiring the inverse matrix and were given no credit. Candidates should be aware that the term 'hence' means that the problem must be solved using a result obtained in the previous part of the question.

Q.5 This question was well answered in general. Candidates should, however, be advised to use a systematic method for row reduction.

Q.6 As reported in previous years, the presentation was often poor – indeed attempts at solutions using mathematical induction continue to be generally below what can reasonably be expected for candidates working for a qualification in Further Mathematics. 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 k and k + 1 so proved by induction'.

Q.7 Most candidates were able to obtain correctly the matrix representing T. Solutions to (b), however, were sometimes disappointing with some candidates obtaining the equations $x' = y - 2$ and $y' = -x - 2$ but not then realising that for the fixed point, $x' = x$ and $y' = y$.

Q.8 Candidates were generally successful in (a) and (b) and it is pleasing to note that most candidates are confident using logarithmic differentiation. Some candidates, however, were unable to obtain the second derivative with some even differentiating x^x as $x \times x^{x-1}$, apparently forgetting what they had done correctly in (a). It was disappointing to note that only a few candidates, having shown correctly that

$$f''(x) = x^{x-1} + x^x(1 + \ln x)^2,$$

spotted immediately that, at a stationary point, the second term is zero and the first term is positive so that there was no need to evaluate $f''(x)$.

Q.9 Solutions to this question were often disappointing and it was the worst answered question on the paper. In (a), most candidates obtained correct expressions for u and v. In (b), however, many candidates were unable to make the required substitution to give the equation of the locus of Q. Most of the candidates who obtained the correct coordinates for C, namely $\left(-\frac{m}{2}, -\frac{1}{2}\right)$ were unable to find the equation of the locus of C as m varies, not realising that the answer is just $v = -\frac{1}{2}$. It would appear, paradoxically, that this question was so difficult because it was so easy.

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Unit	Entry	Max Mark	Mean Mark
FP2	371	75	49.0

Grade Ranges

A	55
B	48
C	41
D	34
E	28

N.B. The marks given above are raw marks and not uniform marks.

FP2

General Comments

The standard of the scripts was generally good.

Individual Questions

Q.1 Most candidates solved this question correctly. The most common error, not seen very often, was to equate each expression for *f*(*x*) and its derivative for *x* = 2.

Q.2 Solutions to this question were generally good. Some candidates, having shown that the *u* limits were [1,e] then, for no apparent reason, changed to [0,e].

Q.3 Most candidates reached the stage $t(t^2-5)=0$ but many then dropped the factor *t* and some even stated that $(t^2-5)=0 \Rightarrow t=\sqrt{5}$. These errors meant that only part of the general solution was given.

Q.4 This was the best answered question on the paper with most candidates obtaining the correct partial fractions and performing the integration correctly.

Q.5 This question was well answered in general.

Q.6 Parts (a) and (b) were well answered by the majority of candidates. In (c), the oblique asymptote *y* = *x* – 6 was sometimes missed or given incorrectly as *y* = *x.* The graph was often drawn incorrectly even when (a), (b) and (c) had been answered correctly.

Q.7 Solutions to this question were disappointing and it was the worst answered question on the paper. In (a) (i), some candidates made algebraic errors in completing the square and in (a) (ii) and (iii), some candidates were unable to translate the focus and directrix correctly. In (b), most candidates found the correct quadratic equation but only a minority of the candidates realised that the gradients of the two tangents could be found by equating the discriminant to zero. Many candidates tried to solve the problem by finding the equation of the tangent at the general point on the parabola and making this pass through the origin but this was not accepted because the question stated 'hence'.

Q.8 Solutions to (a) were good in general and it was pleasing to note that the more mathematically mature candidates were more able to give a well presented proof by induction than FP1 candidates. Solutions to (b) were generally disappointing. In (b) (i), many candidates wrote pages of algebra when all that was required was

$$\left(w(\cos\frac{2\pi}{3}+\mathrm{i}\sin\frac{2\pi}{3})\right)^3 = w^3(\cos 2\pi+\mathrm{i}\sin 2\pi) = w^3 = z$$

In (b) (ii), most candidates wrote down the real cube root of –8 correctly but few candidates used the result in (b) (i) to find the complex cube roots. Most candidates chose to use de Moivre's Theorem to do this, which was acceptable since the question stated 'otherwise', although some candidates were unable to do this successfully. Candidates should be aware that 'otherwise' usually leads to a longer method. Here, all that was required was to find the first complex cube root in the form.

$$-2(\cos\frac{2\pi}{3}+\mathrm{i}\sin\frac{2\pi}{3}) = 1-\sqrt{3}\mathrm{i}$$

and then either to conclude that the second complex cube root was the complex conjugate of the first or multiply by a further $(\cos\frac{2\pi}{3}+\mathrm{i}\sin\frac{2\pi}{3})$.

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Unit	Entry	Max Mark	Mean Mark
FP3	187	75	47.9

Grade Ranges

A	52
B	46
C	40
D	34
E	29

N.B. The marks given above are raw marks and not uniform marks.

FP3

General Comments

The standard of the scripts was generally good with some excellent scripts. Some candidates were unable to handle the algebra involved in solving the question on polar coordinates and solutions to the question on the Newton-Raphson formula were often disappointing.

Individual Questions

Q.1 This was the best answered question on the paper. Some candidates obtained the correct result cosh1 – sinh1. Then they used their calculator to show that both this expression and 1/e were equal to 0.3678794412 correct to 10 decimal places, concluding therefore that cosh1 – sinh1 = 1/e. This was not accepted for the final mark.

Q.2 This question was well answered in general.

Q.3 Most candidates knew what had to be done and the first two derivatives were usually found correctly but algebraic errors were sometimes seen in the evaluation of $f'''(x)$. Some candidates expanded the given series into a power series in *x* and equated this to the Maclaurin series for $\tan^{-1} x$. This, however, is not a valid method.

Q.4 This question required considerable skill in trigonometric manipulation and some candidates were unable to carry this through. Candidates were sometimes unable to see the best method of solution. For example, in (a), the equation $2\cos 2\theta = \sin 2\theta$ had to be solved. The best method here would be to divide both sides by $\cos 2\theta$ to give $\tan 2\theta = 2$. A variety of other methods was seen, for example some candidates rewrote the equation in the form $2\cos^2\theta - 1 = \sin\theta\cos\theta$, squared both sides and replaced $\sin^2\theta$ by $1-\cos^2\theta$ to give a quadratic equation in $\cos^2\theta$. This is a valid method but its complexity invites algebraic errors. Candidates should be advised to take a little time to consider the available options.

Q.5 It has been pointed out in previous reports that some candidates are not aware that if $t = \tan(x/2)$, then $\mathrm{d}x$ has to be replaced by $\frac{2\mathrm{d}t}{1+t^2}$. All candidates should know this result and not have to derive it. Some candidates found difficulty with dealing with the integration of $\frac{1}{7-t^2}$. Although this is a standard result given in the information booklet, it involves either $\tanh^{-1} t$ or a slightly awkward logarithmic expression and some candidates were unable to convert a correct integrated result into the correct numerical value.

Q.6 Parts (a) and (b) (i) were well answered in general but some candidates failed to see the connection between the integral in (b) (ii) and their previous work.

Q.7 Questions on this topic are normally well answered so it was disappointing to note that this was the worst answered question on the paper with many candidates finding the manipulative work in (a) involving hyperbolic functions too difficult for them.

Q.8 This question was well answered in general. The most common error seen was taking the limits in the integrals to be $\pm\pi$, with these candidates thinking, presumably, that the graph provided in the question was a semi-circle.

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