WJEC
CBAC

GCE EXAMINERS' REPORTS

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

SUMMER 2010

Statistical Information

This booklet contains summary details for each unit: number entered; maximum mark available; mean mark achieved; grade ranges. *N.B. These refer to 'raw marks' used in the initial assessment, rather than to the uniform marks reported 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 2010

Advanced Subsidiary/Advanced

Principal Examiner: Dr E W 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	2998	75	40.2

Grade Ranges

A	52
B	45
C	38
D	32
E	26

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

Mathematics - C1

General Comments

Although performance on the majority of questions was good, most candidates seemed to find that this year's paper was more difficult than the corresponding paper last year. The questions which caused most problems were questions 3(*b*) and, to a lesser extent, 4(*b*) and 10.

Individual questions

Q.1 As is invariably the case, the coordinate geometry question caused very few problems and many candidates were able to get full marks.

Q.2 Possibly a slightly more difficult question than usual, but there were many totally correct solutions and most candidates were able to pick up marks on both parts.

Q.3 Part (*a*) was standard and well answered but although two different approaches were possible, many candidates were unable to make any progress in part (*b*).

Q.4 Most candidates were able to gain both marks in part (*a*). Many candidates, however, used an incorrect value for x in part (*b*) and the evaluation of $(-0{\cdot}01)^2$ and $(-0{\cdot}01)^3$ was in general poor.

Q.5 Part (*a*) caused few problems but not all candidates realised the relevance of part (*a*) in finding the least value of the expression in part (*b*).

Q.6 In part (*a*), most candidates were able to conclude that $k^2 - 144 < 0$ but a common error was to interpret this as meaning that the range of values of k was given by $k < 12$. In part (*b*), a majority of candidates were able to find the values $x = -0{\cdot}5$ and $x = 0{\cdot}6$ but not all were then able to proceed to give the correct range of values of x satisfying the given inequality.

Q.7 The differentiation from first principles was well answered and the fact that the coefficient of x^2 was negative seemed to cause very few problems. In part (*b*), many candidates were able to earn the first three marks but relatively few were then able to proceed to the final answer of $\frac{1}{64}$.

Q.8 Part (*a*) was well answered but in part (*b*) not all candidates realised that they already knew that $(x + 2)$ was one of the factors of the given expression.
Part (*c*) proved to be slightly more difficult and it was disappointing that very few candidates used their answer to part (*b*) here.

Q.9 Part (*a*) caused few problems but in part (*b*) some candidates drew the graph of $y = -f(x)$ rather than that of $y = f(-x)$.

Q.10 Most candidates were able to get the correct expression for the derivative but solutions of $1{\cdot}5(x^2 - 4) = 0$ were many and varied.

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Unit	Entry	Max Mark	Mean Mark
C2	4111	75	37.3

Grade Ranges

A	51
B	44
C	37
D	30
E	24

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

Mathematics - C2

General Comments

Candidates found this year's paper to be generally more difficult than the corresponding paper last year. Whereas most of the questions seemed to be accessible and some were very well answered, many candidates were only able to make limited progress on questions 2(*c*) and 10.

Individual questions

Q.1 This question was well answered, as is almost always the case.

Q.2 Parts (*a*) and (*b*) caused very few problems, but many candidates failed to make any kind of start to part (*c*). Several of those who were able to make some progress divided throughout by sin ϕ and unfortunately lost half the solutions.

Q.3 Although there were many correct solutions to part (*a*), some candidates thought that the side of length 6 cm which they had derived from the area formula was the required side *BC* rather than *AC*.

Q.4 The majority of candidates got full marks on this question.

Q.5 Parts (*a*) and (*c*) were well answered but in part (*b*), not all candidates were able to set up and solve the correct quadratic equation.

Q.6 In part (*a*), it was disappointing to see that many candidates were unable to find the value of the common ratio from the given information. In part (*b*)(i), the majority of candidates were able to earn the first two marks by setting up two simultaneous equations, but then only a minority were then able to eliminate *a* from these equations and derive the given quadratic in *r*.

Q.7 This was another question which most candidates found to be relatively straightforward.

Q.8 Some of the attempts at proof in part (*a*) were poor. On the other hand, most candidates were able to get full marks on part (*b*) and in part (*c*), the majority of those candidates who rewrote the given equation as a power equation were then able to derive the correct value for *a*.

Q.9 In this question, the only part which seemed to cause any general problems involved finding the coordinates of *Q* in (*b*)(ii). Part (*c*) was very well answered.

Q.10 This was a disappointing question with relatively few fully correct answers. Many candidates, although being able to express *K* in terms of *R*, *r* and θ were unable to do the same for *L*. Attempts at eliminating θ were poor (see the comment on question 6 above) and only a few candidates were then able to express $R^2 - r^2$ as $(R - r)(R + r)$ and consequently derive the required expression for *r* in terms of *R*, *K* and *L*.

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Unit	**Entry**	**Max Mark**	**Mean Mark**
C3	1519	75	53.0

Grade Ranges

A	61
B	51
C	42
D	33
E	24

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

Mathematics - C3

General Comments

With the exception of one question, candidates found this to be an accessible paper and performance was good. The majority of candidates, however, found difficulty with question 8 and only a small number were able to get full marks here.

Individual questions

Q.1 As is usually the case, the use of Simpson's rule caused very few problems.

Q.2 Both parts of this question were well answered although in part (*b*), some candidates substituted $1 + \sec^2\theta$ for $\tan^2\theta$.

Q.3 There were very few problems here and many candidates were able to gain full marks on this question.

Q.4 Generally very well answered with correct use of the calculator although some candidates lost a mark for an incorrect final statement.

Q.5 Part (*a*) turned out to be relatively straight forward but a small minority of candidates failed to make a start in part (*b*).

Q.6 All parts were well answered.

Q.7 In part (*a*), most candidates were able to deal with the modulus signs correctly and find the required range for x. In part (*b*), almost all candidates were able to draw the graph of $y = |x|$ and then carry out a correct translation it but a minority did not find the y-intercept of the translated graph.

Q.8 Solutions to this question were rather disappointing. In part (*a*), many candidates were unable to differentiate $g(x)$ correctly while others were not able to express $g'(x)$ in the required form. When trying to show that that graph of $y = g(x)$ had only one stationary point, some candidates multiplied out the brackets in the numerator of $g'(x)$ and then either used the quadratic formula or refactorised. Finally, only a few candidates realised that the most appropriate test to find the nature of the stationary point in this case was the first derivative test.

Q.9 This question was very well answered.

Q.10 The only problem which arose with this question was at the end of part (*c*). Most candidates were able to show that $x^2 = 144$ but some then simply omitted $x = -12$ as a solution while others crossed it out since they believed it to be outside the domain of *fg*.

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Unit	Entry	Max Mark	Mean Mark
C4	2643	75	47.5

Grade Ranges

A	61
B	52
C	44
D	36
E	28

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

Mathematics - C4

General Comments

Candidates found this to be an accessible paper. All questions were generally well answered with the exception of question 10 where those candidates who were able to make a start were then usually let down by poor algebraic manipulation.

Individual questions

Q.1 Most candidates knew the correct form for the partial fractions and the majority were then able to proceed to calculate the coefficients. In part (*b*), not all candidates differentiated correctly whilst others integrated the individual terms.

Q.2 This question was very well answered.

Q.3 Part (*a*) caused very few problems. In part (*b*)(i), some candidates expanded $\sin(x - \alpha)$ incorrectly and consequently got an incorrect value for α. Some candidates thought that the least value of the given expression occurred when $\sin(x - \alpha) = 0$.

Q.4 Not all candidates knew how to go about finding the integral of $\sin^2 x$ whilst others who knew they had to involve $\cos 2x$ in some way used the wrong expression.

Q.5 Generally well answered although not everybody was able to write down the range of values of x for which the expansion was valid.

Q.6 Both parts were generally well answered. In part (*b*), some candidates found the two required values of p but did not then proceed to find the coordinates of the two corresponding points.

Q.7 The integration by parts was done well. In part (*b*), some candidates forgot to replace dx by $\frac{1}{2}du$ whilst others did not express x in terms of u.

Q.8 This was a well answered question. The majority of candidates were, however, unable to express the given constant a in terms of their own constant of integration and many just assumed the two to be the same.

Q.9 Another well answered question. In part (*c*), most candidates knew that they had to equate expressions for the coefficients of each of **i**, **j** and **k** and then solve two of these equations simultaneously. Not all candidates, however, verified that the values they had obtained also satisfied the third equation.

Q.10 Very few candidates got many marks on this question. A favourite approach involved squaring both sides but a large number of candidates either thought that $(a + b)^2 = a^2 + b^2$ or that $(2\sqrt{ab})^2 = 2ab$ or both.

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Unit	**Entry**	**Max Mark**	**Mean Mark**
FP1	203	75	43.2

Grade Ranges

A	56
B	48
C	40
D	33
E	26

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

Mathematics - FP1

General Comments

Some excellent scripts were seen but the overall standard was disappointing with many candidates not suited to an examination at this level. The manipulative work was often careless and the presentation of proof by mathematical induction continues to be generally poor.

Comments on Individual Questions

Q.1 This question was well answered by most candidates.

Q.2 Solutions to this question were often poor with algebraic errors in evaluating the required complex number. Some candidates were unable to find the argument of $-1 - 5\mathrm{i}$ correctly. It is important to note that, for a general complex number $z = x + \mathrm{i}y$, it is not true that $\arg(z) = \tan^{-1}\frac{y}{x}$ since the correct quadrant has also to be identified.

Q.3 This question was well answered in general with most candidates finding the inverse of the matrix without making algebraic errors along the way. In (b), some candidates failed to take note of the word 'hence' and solved the equations using row operations. No credit was given for this method.

Q.4 Solutions to this question were generally disappointing. Most candidates knew what to do but many were unable to handle the necessary algebra without making errors. Some candidates solved the quadratic equation, obtaining the roots $-1 \pm \sqrt{2}\mathrm{i}$, and then tried to calculate numerical values for the new roots. At least one successful solution was seen using this method, but most of the candidates trying this method were unable to do the arithmetic correctly and this method is not recommended.

Q.5 As reported previously, the presentation was extremely 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. 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 $n = k$'. 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.6 Most candidates found the partial fractions correctly but only a minority of candidates were then able to use their result to sum the series in (b).

Q.7 Most candidates recognised this as a problem in which logarithmic differentiation should be used but algebraic errors meant that marks were lost in attempting to locate the stationary point and to classify it.

Q.8 Parts (a) and (b) were generally well done but (b)(ii) caused problems for many candidates who misread the question. Questions on this topic have usually asked for the image of a line under a transformation. This time however, the equation of the image was given and candidates were required to find the equation of the original line. Many candidates failed to spot that the question was being asked in reverse although partial credit was given for solving the wrong problem correctly.

Q.9 Solutions to this question were disappointing and it was the worst answered question on the paper. Many candidates failed to obtain correct expressions for *u* and *v* which meant that (b) was inaccessible unless follow through could be applied to their incorrect expressions which only happened in a few cases. Most candidates were unable to make a start to (c), not realising that it simply required the equation $z = \frac{1}{1-z}$ to be solved.

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Unit	**Entry**	**Max Mark**	**Mean Mark**
FP2	265	75	46.8

Grade Ranges

A	52
B	45
C	38
D	31
E	25

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

Mathematics - FP2

General Comments

The standard of the scripts was generally good.

Comments on Individual Questions

Q.1 Most candidates solved this question correctly.

Q.2 Solutions to this question were also generally good. Most candidates found correct values for the modulus and argument in (a) and went on to find the cube root in the first quadrant. Some candidates then carried on to make errors in the arguments of the other two cube roots.

Q.3 Most candidates obtained the given quadratic equation successfully, found the two roots and then found the two possible values of $\frac{x}{2}$. However, in attempting to find the general solution, some candidates multiplied by 2 and then added 180° instead of adding 180° and then multiplying by 2.

Q.4 Most candidates obtained the correct partial fractions in (a). However, in (b), some candidates gave a log function as the integral of $\frac{1}{x^2+2}$ instead of $\tan^{-1}$ and others were careless in the evaluation of the definite integral.

Q.5 Solutions were often disappointing with algebraic errors common in the expansion of $(\cos\theta + i\sin\theta)^5$. Attempts at finding the limit at the end of the question were often disappointing. Candidates who evaluated the limit by putting a very small value of θ in their calculators and obtained 4.9999999.. = 5 were given no credit. This is of doubtful validity and in any case the question said 'Deduce'.

Q.6 Most candidates located the stationary point correctly. The graph, however, was sometimes incorrectly drawn with incorrect approaches to the vertical asymptote and omission of the horizontal asymptote. Only a minority of candidates solved (d) completely although many realised that the solution depended in some way on the equation $\frac{x}{(x-1)^2} = 2$. Candidates need to be aware that the graph is extremely helpful in solving this type of problem.

Q.7 Candidates found this question difficult and it was the worst answered question in the paper. Most candidates were able to show that *g* and *h* were even and odd but few went on to show that *f* could be expressed as the sum of an even function and an odd function. Although the solution to (b) depended on fairly basic properties of logs, many candidates were unable to carry out the necessary algebra.

Q.8 Many candidates were unable to locate the focus and directrix correctly, not knowing how to deal with the fact that *x* and *y* are interchanged compared with the standard form. Part (a)(iii) caused problems for many candidates who failed to realise that the product of the two roots of the given equation was – 1.

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Unit	**Entry**	**Max Mark**	**Mean Mark**
FP3	95	75	50.5

Grade Ranges

A	50
B	44
C	38
D	32
E	27

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

Mathematics - FP3

General Comments

The standard of the scripts was generally good with some excellent scripts. As noted last year, questions involving reduction formula continue to cause problems for some candidates and the algebra involved in solving questions on polar coordinates is too difficult for some.

Comments on Individual Questions

Q.1 Parts (a) and (b) were well answered by most candidates. In (c), however, although most candidates found $f''(x)$ correctly, some thought, rather curiously but incorrectly, that the classification of the stationary point depended in some way on the solution of the equation $f''(x) = 0$.

Q.2 This question was well answered in general, the most common error being the use of an incorrect formula for $\sinh^2 u$.

Q.3 Most candidates are comfortable solving problems involving iterative formula and this question was well answered in general with the exception of (c)(i) where relatively few candidates seemed aware of the condition for the convergence of iterative sequences of the form $x_{n+1} = F(x_n)$.

Q.4 This question was well answered by many candidates, the most common errors arising from incorrect arithmetic in integrating $\sqrt{1+\frac{9x}{4}}$.

Q.5 It was pleasing to note that so many candidates carried out the necessary differentiation in (a)(i) correctly thereby obtaining a correct Maclaurin series. In (a)(ii), few candidates gave the simple reason, namely that the series contains both even and odd powers of *x*. Part (b) was correctly answered by most candidates.

Q.6 This was the worst answered question on the paper. In (a), many candidates attempting to maximise $y = r\sin\theta$ obtained the equation $\sin 2\theta = 2\cos 2\theta$ but then failed to realise that this reduced to $\tan 2\theta = 2$, choosing instead to use double angle expansions which often lead to an incorrect conclusion. In (b), the algebra involved in the integration of $(\cos\theta + 2\sin\theta)^2$ proved to be beyond some of the candidates.

Q.7 Many candidates were unable to derive the recurrence relation in (a). A common method seen was to rewrite $\cos^n x$ as $\cos^2 x.\cos^{n-2} x$ presumably on the grounds that the target result involved I_n and I_{n-2} but this decomposition leads nowhere. However, most candidates solved (b)(i) correctly but some candidates failed to spot the connection between the given integral and I_n in (b)(ii).

WJEC
245 Western Avenue
Cardiff CF5 2YX
Tel No 029 2026 5000
Fax 029 2057 5994
E-mail: exams@wjec.co.uk
website: www.wjec.co.uk