WJEC
CBAC

GCE EXAMINERS' REPORTS

MATHEMATICS (M1 - M3 and S1 - S3)
AS/Advanced

SUMMER 2011

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 2011

Advanced Subsidiary/Advanced

Principal Examiner: Dr. S.Y. Barham

Unit Statistics

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Unit	Entry	Max Mark	Mean Mark
M1	2491	75	43.2

Grade Ranges

A	55
B	46
C	38
D	30
E	22

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

M1

General Comments

This proved to be a good paper well received by the candidates who generally found all questions to be within their capabilities. It is of a standard and length commensurate with papers on this syllabus in previous examinations. There were no surprises in the candidates' performance with question 4 proving problematic owing to candidates' inability to translate the requirements of the question into a force diagram. Question 9(b) was not as well done as usual as candidates tried to rely on their imagination rather than drawing a diagram.

Individual Question

Q.1 This question was extremely well done by all except the weakest candidates. It is very nice to find a question which starts the paper so auspiciously for so many candidates.

Q.2 Part (a) was well done generally. In part (b), it was necessary to isolate the forces on the person in the lift, and most candidates who did that went on to give a correct solution.

Q.3 A surprising number of candidates assumed that the acceleration is zero. This loses most of the marks available in the question. A number of candidates obtained two different values of the acceleration for the two stages of the motion in spite of being told that the acceleration was constant throughout the motion. However, generally, the candidates seemed to know what was required and did this question without any difficulty.

Q.4 This proved to be the most difficult question on the paper and many candidates who did excellently in all the rest of the paper failed to present a correct solution. Those who drew a force diagram generally were successful at solving, even those who used a tension rather than a thrust in AC. Large numbers of candidates simply resolved the weight of the sign in the direction AB and the direction AC, losing all the mark. There were some very nice solutions using Pythagoras' theorem which works in this question as the directions of the forces formed a right angled triangle.

Q.5 This question was well done generally with most candidates finding the component of weight of the particle down the slope successfully and using it correctly in the N2L equation. Some candidates preferred to work with the angle rather than the given value of sine. Such candidates should work with a sufficiently accurate angle rather than rounding the angle to 37 degrees as that incurred an accuracy penalty.

Q.6 This question was well done generally though some candidates had trouble with the N2L equation when the acceleration is zero. Many candidates who had trouble with part (a) managed to do part (b) successfully as here, the coefficient of friction is given.

Q.7 As the particles were moving towards each other, one of the initial velocities is negative in the conservation of momentum and the restitution equation. Numerous candidates found this difficult to deal with, and more sign errors than usual were seen.

Q.8 There does seem to be an improvement in the quality of the solutions to question on this topic in the last couple of years. Part (a) was generally well done. In part (b), candidates who did not realise that the circumstances described in the question meant that the reaction at support Y is zero gained no marks.

Q.9 Candidates could see the lamina as a triangle minus another triangle or as a rectangle with two triangles added. Both methods were equally successful. In part (b), many candidates could not identify the correct triangle, this proving rather more difficult than question of this type in previous years.

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Unit	Entry	Max Mark	Mean Mark
M2	862	75	54.9

Grade Ranges

A	63
B	54
C	45
D	37
E	29

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

M2

General Comments

This proved to be a very straight forward paper, generally accessible to candidates and lacking in challenge for the better candidates. It is rather less demanding then papers on this syllabus in previous years particularly for the good candidates. Many extremely good scripts were seen and fewer than usual bad scripts were presented. All the questions were equally well done.

Individual Question

Q.1 This question was well done by most candidates and provided a good start to the paper. A few candidates mixed up integration and differentiation and a few more omitted the constant of integration.

Q.2 Candidates who remembered the equations connecting velocity and angular velocity for horizontal circular motion were usually successful in gaining 4 marks.

Q.3 Most candidates were successful in differentiating the vector **v** though many made mistake in differentiating the constant. Some candidates did not realise that to obtain the force vector, all that is required is to multiply the acceleration by the mass. In part (b), candidates realised the dot product was required, but many incorrectly retained the vectors **i**, **j** and **k**. A variety of unit were presented as units for power but the majority gave the correct Watts as their answer. Some resorted to dimensions.

Q.4 This question was generally well done. Only a few candidates did not manage to include both the resistance and the component of weight down the slope.

Q.5 There was a good response to this question with many candidates gaining full marks, and almost all candidates included all three types of energies, potential, kinetic and elastic in their conservation of energy equation. However there were many errors in the calculation of the difference in potential energy.

Q.6 Many similar questions have been set in previous years and this was well done generally. The most common error occurred on part (a) where candidates made a sign error, commonly using +100 instead of the correct -100 when using g = - 9.8. It was disappointing that some candidates could not solve the consequent quadratic equation because it did not factorise.

Q.7 A surprising number of candidates obtained full marks for this question. Generally, candidates realised what was required. However, many errors occurred when performing the simple algebra involved in finding AB and then the distance AB^2, which was rather a pity.

Q.8 No surprises were seen in marking this question. All but a few candidates lost the last 2 marks in part (d). Generally, candidates realised that the tension found in part (b) was no longer relevant as a rod could provide a thrust as well as a tension, but they did not then go on to consider whether there was sufficient energy for the particle to reach the top of the circular path in order to describe complete circles. They failed to consider the expression for v^2 found in part (a)

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Unit	Entry	Max Mark	Mean Mark
M3	176	75	52.0

Grade Ranges

A	57
B	49
C	41
D	34
E	27

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

M3

General Comments

This paper seemed to be of the same standard as length as papers on this syllabus in recent years. However, there seemed to be fewer candidates than usual who managed to gain top marks. There were also fewer candidates than usual gaining marks in the single figures. The bookwork on Simple Harmonic Motion required in question 3(a) was not generally well known and only a handful of candidates managed to gain the 6 marks available there. Question 6 on statics proved problematic for many candidates, even those who gained top marks elsewhere on the paper.

Individual Question

Q.1 This question was generally well done by many candidates with the most common errors occurring in the integration of $\frac{1}{5+2v}$. The most common error being the omission of the factor $\frac{1}{2}$, and sometimes the insertion of a negative sign.

Q.2 Well done generally with some candidates applying the initial conditions to the complementary function rather than the general solution.

Q.3 Only part (a) proved problematic. However, candidates managed to recover by finding the necessary ω=8 from the given period, often gaining full marks from the rest of the question.

Q.4 The most common error in this question is the omission of the sign right at the start of the question when applying N2L. This loses the candidates 2 marks out of the available 10.

Q.5 Almost everyone managed to obtain the 3 marks in part (a0, either by using suvat equations or by using energy considerations. Part (b) was also well done generally.

Q.6 With a correct force diagram, almost every candidate knew to take moments, usually about A or B to obtain either the thrust T in DB or the vertical component of the reaction at the hinge A. Candidates also knew to resolve vertically and horizontally to obtain 2 other equation, thus solving the question completely. The problem is that not many candidates managed to draw a correct force diagram on the rod. Commonly, candidates put in a reaction at B, sometimes even one at C. Some even included a reaction at D which is not relevant to the equilibrium of the rod AC. One or two even put the weight of the rod AC acting in the middle of the light rod DB. An incorrect force diagram loses almost all the available marks in the question.

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Unit	Entry	Max Mark	Mean Mark
S1	2760	75	44.5

Grade Ranges

A	58
B	49
C	41
D	33
E	25

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

S1

General Comments

As usual, the candidature was extremely variable with many candidates completely out of their depth at this level but also many candidates submitting excellent scripts. A disappointing feature this year was the poor response to parts of questions requiring comment, in particular Q2(b) and Q7(a).

Individual Questions

Q.1 This was the best answered question on the paper. Some candidates drew a tree diagram although for this type of problem a tree diagram is so large that it becomes difficult to manage.

Q.2 Part (a) was well answered in general but the response to (b) was usually extremely poor. Many incorrect reasons were given, eg 'It could be binomial with equal mean and variance', which of course is impossible, and 'It cannot be Poisson if the mean and variance are equal'. Many candidates did not even attempt to answer (b).

Q.3 A variety of methods was seen here, some correct and some incorrect, although the presentation was often poor. A Venn diagram would have been helpful although this was not often seen. In (a), the reverse argument was fairly common in which A and B were assumed to be mutually exclusive leading to $\mathrm{P}(A \cup B) = 0.65$ so that $\mathrm{P}(A' \cap B') = 0.35$ which is a contradiction. This is, of course, a valid method but it was sometimes used with little or no explanation. Again in (b), it was not always clear what was actually being done with equations, some correct and some incorrect, being written in a haphazard way in many scripts. The most concise solution, seen only once, was to show that
$\mathrm{P}(A') = 0.75, \mathrm{P}(B') = 0.6$ so that $\mathrm{P}(A') \times \mathrm{P}(B') = 0.45 = \mathrm{P}(A' \cap B')$
Therefore A and B are independent (this of course assumes that A', B' independent implies that A,B are independent but this was accepted). Finally, because A,B are independent they cannot be mutually exclusive.

Q.4 This question was well answered in general although (c) caused problems for some candidates.

Q.5 Parts (a) and (b) were well answered with arithmetic errors causing the greatest loss in marks. In (c), however, some candidates thought incorrectly that 1 and 3 can happen in only one way and/or 2 and 2 can happen in two ways.

Q.6 Questions on the use of the Law of Total Probability and Bayes' Theorem are usually well answered and this was the case in (a) and (b) although most candidates were unable to answer (c). It would appear that most candidates do not realise that Bayes' Theorem is used to update probabilities. Here, at the beginning of the problem, the probability of the selected coin being double headed is 1/3. Having tossed the coin three times obtaining three heads, Bayes' Theorem is then used in (b) to update this probability to 4/5. In (c), therefore, the Law of Total Probability or a tree diagram can be used to determine the required probability. Most candidates failed to use an updated probability in (c).

Q.7 Solutions to (a) were extremely disappointing with few candidates giving the two conditions, ie independent trials and constant probability. The most common response was that p should not exceed 0.5 and n should not exceed 100. These are, of course, conditions imposed by the statistical tables provided and nothing at all to do with the derivation of the binomial formula. Some candidates simply combined what they considered to be appropriate words in the hope of being correct, eg 'Trials must be dependent and mutually exclusive' was seen on several occasions. Parts (b) and (c) were well done in general although some candidates misinterpreted the term 'less than'.

Q.8 Solutions to (a) were better in general than previous years' questions on this topic and the use of calculus seems to have improved this year. Part (b), however, caused problems for many candidates who seemed unsure how to make a start. Some candidates thought that (b) was a continuation of (a) although the use of different letters for the random variables should have made it clear that this was not the case.

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Unit	Entry	Max Mark	Mean Mark
S2	913	75	49.5

Grade Ranges

A	56
B	48
C	41
D	34
E	27

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

S2

General Comments

The general standard was good with a handful of excellent scripts. The following sentences are taken from the last two years' reports and they are repeated because they still apply. Continuity corrections continue to be a source of difficulty for many candidates with either incorrect or no correction being used. In some cases, the interpretation of *p*-values is unsatisfactory – candidates are recommended to use the guidelines in the specification. Some candidates interpret a *p*-value as offering **some** evidence pointing to one or other of the hypotheses which is altogether too vague. Also, some candidates fail to give a conclusion in context when this is asked for. As in previous years, the question on the uniform distribution was the worst answered question on the paper.

Individual Questions

Q.1 This was well answered by most candidates. The most common error was an incorrect calculation of variance in (a)(ii) and (b).

Q.2 Part (a) was well answered in general. In (b) some candidates wrote the inequality for *n* incorrectly as

$$1.96\times\frac{0.5}{\sqrt{n}}<0.1 \text{ instead of } 3.92\times\frac{0.5}{\sqrt{n}}<0.1$$

Some candidates were unable to solve their inequality for *n* and some forgot to round their value upwards to the next integer.

Q.3 This was the best answered question on the paper, the most common error being the use of an incorrect or no continuity correction in (c). In (a), candidates who gave the hypotheses as $\mathrm{H}_0:\bar{x}=0.5;\mathrm{H}_1:\bar{x}<0.5$ were given no credit

Q.4 This question was well answered in general. Some candidates forgot to double the probability in the tables to give the *p*-value to allow for the two-sided alternative hypothesis. Some candidates failed to match their conclusion to the zoologist's belief; candidates who gave their conclusion as 'Accept H_0' or equivalent were given no credit.

Q.5 This question was easily the worst answered question on the paper. In (a), some candidates failed to give the domain of the probability density function. Many candidates ignored the word **hence** in (a). The requirement here was for candidates to derive the expression for $\mathrm{E}(U^2)$ using integration and candidates who used the expressions in the formula booklet to obtain the result were given no credit. In (b), most candidates found the mean and variance of *X* correctly and also gave the correct expression for *Y* in terms of *X*. It was, however, disappointing that so many candidates went on to calculate E(*XY*) as E(*X*)E(*Y*) which is of course incorrect because *X* and *Y* are not independent. Candidates were expected to show that

$$\mathrm{E}(XY) = \mathrm{E}[X(12 - X)] = 12\mathrm{E}(X) - \mathrm{E}(X^2)$$

and then to use the results obtained earlier in the question. Part (c) was well answered by many candidates although some candidates used a continuity correction which was not appropriate here.

Q.6 This question was well answered by many candidates. The most common error in (a) was to misinterpret the given information. In (b), an incorrect or no continuity correction was sometimes used.

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Unit	Entry	Max Mark	Mean Mark
S3	141	75	57.7

Grade Ranges

A	60
B	51
C	43
D	35
E	27

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

S3

General Comments

The number of candidates sitting S3 has doubled compared to 2010 but the standard of the scripts remained generally good with some excellent scripts. Questions on statistical inference are generally well done by most candidates although questions on estimation theory cause problems for some candidates.

Individual Questions

Q.1 This was the best answered question on the paper and it was well answered by almost all the candidates.

Q.2 This question was well answered in general. In (b), the variance should have been estimated by dividing by 99 although division by 100 was accepted in view of the large value of *n*. Some candidates forgot to multiply the probability obtained from the table by 2 to allow for the two-sided alternative hypothesis and some candidates failed to give the conclusion in context.

Q.3 Part (a) was well answered by the majority of candidates although in (b), some candidates failed to understand what was required.

Q.4 Most candidates calculated the unbiased estimates for μ and σ^2 correctly and most realised that, since the sample was small and the variance was estimated, the Student's *t*-distribution, and not the normal distribution, should be used to construct the confidence interval.

Q.5 This was the second best answered question on the paper and most of the marks that were lost were due to arithmetic errors. In (b), the variance should have been estimated by dividing by 59 although division by 60 was accepted in view of the large value of *n*. Some candidates lost the final mark by failing to relate their conclusion to the manager's belief.

Q.6 In (a), most candidates estimated α and β correctly, almost invariably by first calculating S_{xx} and S_{xy}. Solutions to (b) were sometimes disappointing, the most common errors being the use of an incorrect estimate for the solubility at 17ºC and the use of an incorrect expression for the standard error of this estimate. This often gave an answer which was clearly wrong and the candidates should have realised that. It is obvious, looking at the data, that the confidence interval should lie within the interval [29.6,31.7] and any answer outside that range should be checked.

Q.7 This was the worst answered question on the paper. Although the question was well signposted, some candidates were unable to carry out the appropriate algebra. It was, however, pleasing to note that some candidates, unable to work through the question, nevertheless picked up the final mark by identifying correctly the better estimator.

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