WJEC
CBAC

GCE EXAMINERS' REPORTS

MATHEMATICS (M1 - M3 and S1 - S3)
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 S Barham

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
M1	2195	75	46.5

Grade Ranges

A	58
B	49
C	40
D	32
E	24

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

Mathematics - M1

General Comments

This paper was of a standard and length commensurate with those of previous years on this syllabus. It caused very little problems to the reasonable candidate and full marks were obtained on all the questions. Questions on some areas of the syllabus are still not particularly well done generally. In particular, question 7 on equilibrium under parallel forces was not well done generally.

Comments on individual questions

Q.1 This question provided a good start to the paper for many candidates. As all values were positive if the direction of motion was taken as positive downwards, there were very few sign errors.

Q.2 Parts (a) and (b) did not cause many problems. Some candidates attempted the area of a trapezium, not always using the correct formula, but most candidates divided the area up into two triangles and a rectangle. Sign errors were common in part (c) with candidates not being consistent in using upward/downwards as positive. Generally, candidates who used the direction of motion of the lift as the positive direction were rather more successful.

Q.3 This question was well done generally except for candidates who did not multiply the masses by the acceleration due to gravity g to convert the kilogrammes to Newtons. This makes the Newton Second Law equation dimensionally incorrect. Such candidates paid a heavy penalty as no marks were then available.

Q.4 Rather fewer sign errors were seen this year as the initial velocities of both particles were in the same direction. The usual errors were common in the restitution equation with e being on the wrong side or the velocities subtracted in the wrong order. A great many unconventional and incorrect units were seen for the impulse. However there was no mark allocated for the units this year.

Q.5 In part (a), many candidates simply quoted the equations relevant for two particles hanging from a smooth light pulley and ignored friction altogether. Others who took friction into account in applying Newton's Second Law to the particle on the table also included the weight of the particle, which was acting in a perpendicular direction, in their equation. Only a handful of correct answers for part (b) were seen.

Q.6 As in previous years, candidates were able resolve in two perpendicular directions to obtain the relevant components but were less competent in combining them to find the magnitude of the resultant and its direction. There were also many sin/cos errors as well as sign errors.

Q.7 Most candidates realised that this is a question on moments and were also able to use force $\times$ perpendicular distance. However, within an equation, they were not always consistent with the point they were taking moments about. Many candidates thought that the required force equals the moments about the point of action of the force. Others omitted the weight of the rod altogether.

Q.8 This is a suvat question involving two unknowns, the initial velocity u and the constant acceleration a. Many candidates were able to write down one relevant equation correctly, usually for the motion between points *A* and *B*. However, they failed to note that a second equation could be obtained by considering the motion between *A* and *C* but considered the motion between *B* and *C* instead. This introduced a third variable, being the velocity at *B*. Unfortunately, they also labelled this u, leading to great confusion and an erroneous solution. Few candidates going down this route were successful.

Q.9 The concepts required in this question were generally well understood. However, in part (a), a large proportion of candidates removed the triangle instead of adding it. A full follow through was given for part (b) for those candidates who correctly identify the required angle and the relevant triangle.

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Unit	Entry	Max Mark	Mean Mark
M2	734	75	50.1

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.

Mathematics - M2

General comments

This paper provided a good vehicle for candidates to demonstrate their competence on this subject. Only question was generally poorly done. The standard and length of the paper were satisfactory.

Comments on individual questions

Q.1 This question was well done generally though numerical errors were common in Part(c) and many candidates lost the last mark.

Q.2 The first three parts of the question were well done generally. Some candidates were not able to make a sensible attempt at part (d) and there were many incorrect versions of $\underline{a}.\underline{b} = |a||b| \cos\theta$.

Q.3 Disappointingly, part (a) was not generally well done with some candidates equating the tension with the elastic energy. In part (b), almost everyone knew to use conservation of energy. However, many candidates left out one of the energies, either potential or elastic. Candidates who realised all three energies were present often used the incorrect height for the potential energy and also the incorrect extension for the elastic energy in spite of having obtained the correct answer in part (a).

Q.4 As usual, many candidates obtained full marks on this question. The most common error is losing the component of weight acting down the slope or losing the resistance.

Q.5 Many candidates had difficulty with part (a) but were able to use the answer provided to obtain full marks in parts (b) and (c). Sign errors seem less common. However, some candidates did not realise the equation of motion is capable of describing the whole of the motion and used a multistage method splitting the upwards motion from the downward motion.

Q.6 This question had the poorest response on the paper and indeed the poorest response for question of this type for many years. Many candidates were unable to make a sensible attempt. Many ignored the fiction altogether and many only gained the two marks available for the use of $F = \mu R$ and $a = \frac{v^2}{r}$ for circular motion. Of those who made a serious attempt, many resolved perpendicular to the plane to obtain $R = mg\cos\alpha$, neglecting the effect of the acceleration towards the centre of motion. However, many were able to write down a correct Newton's Second Law equation towards the centre.

Q.7 This was a standard question on vertical circular motion and was well done generally. In part (a), some candidates substituted $\cos\theta = 0.5$ immediately and did not obtain an expression for v^2 for a general θ requested for in the question. These candidates then substituted $v = 13$ into the equation for the tension in part (b), losing two marks. Part(c) was reasonable well done with some candidates making the mistake of considering v^2 instead of the tension in the string. Some candidates started from scratch instead of using the answer in part (b).

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Unit	Entry	Max Mark	Mean Mark
M3	148	75	52.3

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.

Mathematics - M3

General Comments

This paper did not present any unexpected problems to the candidates and is of a standard and length commensurate with past papers on this syllabus. There were many scripts which demonstrated the extreme competence of the candidates and very few were not properly prepared for this examination. Generally, the scripts were a pleasure to mark though some candidates' presentation could be improved and some did not present a diagram with their solution leaving the marker guessing as to which forces were represented by the various labels.

Comments on individual question

Q.1 This question was well done generally with many candidates gaining full marks although some candidates were confused by the absence of initial conditions and did not realise that the constant of integration cancels out in the subtraction or in the use of limits in the integration.

Q.2 All parts were well done generally except for (b) and (e). In (b), many candidates were not able to use Newton's Second Law successfully in this situation and many did not make an attempt or used a range of inappropriate methods such as conservation of energy. Others used a circular argument. Follow through marks were available for an incorrect amplitude. In (e) many used the sin form of the displacement without adjusting for the phase difference.

Q.3 As usual, this question was very well done with many candidates gaining full or nearly full marks. A small number of candidates attempted to find the constants by using the initial conditions in the Complimentary Function instead of in the General Solution. This loses the last four marks in the question.

Q.4 This question used to be poorly done but this is no longer the case and the majority of candidates obtained full or nearly full marks. Some candidates failed to realise that the speed of the particle Q has 2 components to be found and was satisfied with only one component, losing the last 3 marks. A few candidates were not able to ascertain the correct angle required in the calculation and substituted 45° instead.

Q.5 Except for candidates who did not spot the ln integral, this question was reasonably well done though there were a variety of errors in part (d) involved in making v^2 the subject of the equation.

Q.6 This question was well done in comparison to those on this topic in recent years. Generally, candidates were able to obtain the three equations required by taking moments about B and equating horizontal components and vertical components fo forces. The most serious error was the omission of the friction at the wall or putting the friction at the wall in the incorrect direction. Many candidates did not present a diagram with the forces labelled clearly so that it is impossible to tell if the equations presented were correct or incorrect, especially when there were errors in the solution. Sin/Cos errors were also common in the moments equation.

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Unit	Entry	Max Mark	Mean Mark
S1	2692	75	38.8

Grade Ranges

A	51
B	44
C	37
D	30
E	23

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

Mathematics - S1

General Comments

The candidature was extremely variable with many candidates completely out of their depth at this level but also many candidates submitting excellent scripts. Solutions to the question on continuous distributions were again generally poor with many candidates showing poor skills in the use of calculus.

Comments on Individual Questions

Q.1 Part (a) was well answered by the majority of candidates. Part (b), however, proved to be surprisingly difficult for many candidates with $P(A \cap B')$ found instead of $P(A \cup B')$. Candidates who drew a Venn diagram were generally more successful than those who relied solely on algebra.

Q.2 Most candidates found E(*Y*) correctly but Var(*Y*) caused problems for some with incorrect formulae seen, notably Var(*Y*) = 3Var(*X*) and Var(*Y*) = 9Var(*X*) – 1. Some candidates also stated, incorrectly, that $\mathrm{E}(Y^2) = \left(\mathrm{E}(Y)\right)^2$.

Q.3 Unfortunately, some candidates failed to notice that *t* was measured in minutes, assuming instead that it was measured in hours. This illustrates the importance of reading the question carefully. Candidates who made this error should perhaps have realised that a shop with, on average, one candidate every 10 hours was not really a feasible context. In (b), the intention was for candidates to solve the equation $\mathrm{e}^{-0.1t} = 0.25$ using logs although candidates who obtained an approximate answer using tables were given partial credit.

Q.4 Part (a) was well answered in general, (b) was reasonably well answered but (c) proved to be beyond the capabilities of most candidates. Few candidates realised that the required probability had to be found by summing an infinite geometric series. This was the worst answered question on the paper.

Q.5 Questions on the use of the Law of Total Probability and Bayes' Theorem are usually well answered but this one caused more problems than usual. Perhaps the stumbling block was the fact that, in the tree diagram, the branch corresponding to knowing the correct answer did not split into two further branches as is usually the case since the probability of giving the correct answer in that situation is 1.

Q.6 This question was well answered by many candidates. The most common errors in (b)(i) were to fail to realise that a 5 and a 1 could occur in two ways and to believe that a 3 and a 3 could occur in two ways.

Q.7 This question was well answered by many candidates. The most common error continues to be inaccurate use of tables with candidates often giving numbers from adjacent rows or columns.

Q.8 Solutions to this question were generally disappointing with many candidates showing a poor understanding of calculus. In (a), explanations were sometimes unconvincing with the final conclusion based on incorrect reasoning. Solutions to (c) were often poor. As reported previously, the incorrect notation $F(x) = \int_0^x f(x)\mathrm{d}x$ was fairly common. Candidates should be encouraged not to use the same letter to denote both the upper limit and the variable of integration – this will only cause confusion to candidates studying mathematics to a higher level. As stated in last year's report, the limits were often omitted – it is of course a valid method to state that

$F(x) = \int f(x)\,\mathrm{d}x$ + C and then choose C so that either $F(x) = 0$ at the lower limit or $F(x) = 1$ at the upper limit although it is more advisable to find $F(x)$ using a definite integral as above. Few candidates were able to find the value of the median. Even when the correct equation, $2m^4 - 4m^2 + 1 = 0,$ was found most candidates failed to spot that this is a quadratic equation in m^2.

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Unit	Entry	Max Mark	Mean Mark
S2	824	75	50.9

Grade Ranges

A	59
B	50
C	42
D	34
E	26

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

Mathematics - S2

General Comments

The general standard was good with a handful of excellent scripts. The following sentences are taken from last year's report but 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. It was extremely disappointing to note that only a minority of candidates were able to derive the area of a right angled triangle in Ques 5. It was also noted that inappropriate notation was sometimes used in defining the hypotheses. For example, in Ques 3(b), H_0 was sometimes given as $\bar{x} = 12$ and in Ques 6 as $\mu = 0.75$, neither of which was given any credit.

Comments on Individual Questions

Q.1 This was well answered by most candidates. The most common error was a confusion between $\sum_{i=1}^{10} X_1$ and 10*X* in (b). A few candidates seemed to be unaware of the number of grams in a kilogram.

Q.2 In (a), some candidates calculated both $P(X \leq 9)$ and $P(X \geq 22)$ correctly but then failed to realise that these had to be added to give the significance level. Part (b) was well done in general apart from the general comments given above.

Q.3 This question was well answered in general.

Q.4 Most candidates solved (a) correctly but solutions to (b) were often disappointing. Most candidates realised that, for independent random variables *X* and *Y*, E(*XY*) = E(*X*)E(*Y*) but many also believed, incorrectly, that Var(*XY*) = Var(*X*)Var(*Y*).

Q.5 This question was easily the worst answered question on the paper with the majority of candidates unable even to show that the area of the triangle was $4\sin 2\theta$. Most candidates realised in (b) that the solution was given by $P\left(\sin 2\theta \leq \frac{1}{2}\right)$ but many then reduced this incorrectly to $P\left(\sin\theta \leq \frac{1}{4}\right)$. In (c), a fairly common solution was based on the false assumption that $E(\sin 2\theta) = \sin 2[E(\theta)]$.

Q.6 Part (b)(i) was well answered in general. However, in (b)(ii), some candidates were unable to translate the given statement into mathematics with the probability of the complementary event often seen. Also, the conclusion was often not given in context as required.

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Unit	Entry	Max Mark	Mean Mark
S3	74	75	60.1

Grade Ranges

A	61
B	53
C	45
D	37
E	29

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

Mathematics - S3

General Comments

The standard of the scripts was generally good with some excellent scripts. Statistical inference is well understood by most of these candidates although questions on estimation theory cause manipulative problems for some candidates.

Comments on Individual Questions

Q.1 This question was well answered by the majority of 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*. Solutions to (c), however, were often disappointing. As reported last year, many candidates believe that the Central Limit Theorem states that the distribution itself, rather than the sample mean, is approximately normal for large samples, apparently failing to realise that the taking of a sample cannot possibly affect the sampled distribution.

Q.3 This question was well answered by the majority of candidates.

Q.4 Most candidates 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 determine the confidence interval.

Q.5 Most candidates knew what had to be done in this question but some made arithmetic errors along the way. For the same reason as in Q2, division by 75 for estimating the variance was accepted. Some candidates did not read (a) carefully enough and failed to multiply the tabular value of *p* by 2.

Q.6 This was the worst answered question on the paper. Most candidates solved (a) correctly but in (b), some candidates were unable to determine the variance of *U* and it was disappointing to note that some candidates wrote $U = \theta$ instead of $E(U) = \theta$. In (c), some candidates failed to spot that *N* was binomially distributed and were therefore unable to proceed. It was pleasing to note that most candidates who were unable to derive the inequality in (d) nevertheless picked up the final mark by identifying correctly the better estimator.

Q.7 Candidates are generally well prepared for questions on this topic and most candidates estimated $\alpha \text{ and } \beta$ correctly, almost invariably by first calculating $S_{xx} \text{ and } S_{xy}$. Part (b) was also well answered in general, the most common error being the use of an incorrect expression for the standard error of *a*. Candidates could be advised to check their answers if there is time to do that at the end of the examination. The value of *b* can be estimated approximately by dividing the difference of the extreme values of *y* by the difference of the extreme values of *x*, here (2.95 – 2.02)/(60 – 10) = 0.0186. The value of *a* can be estimated by looking at the data and trying to estimate the value of *y* when *x* = 0. Here, the values of *y* are increasing by 0.0186 on average as *x* increases by 10 which gives the estimate *a* = 1.83.

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