GCE 2005
January Series

Report on the Examination

Mathematics

- Advanced Subsidiary
- Advanced

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Advanced Subsidiary and Advanced
(5361, 5366, 5371, 6361, 6366, 6371)

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Mathematics – January 2005

MPC1 Pure Core 1

General

A pleasing number of candidates produced work of a very high standard and most candidates appeared to be well prepared for this examination. Even weaker candidates had the opportunity to demonstrate basic skills such as differentiation, integration and solving quadratic equations.

Question 1

(a)(i) It was not uncommon to see the gradient written as $\frac{-3}{-12}$, which was then cancelled down to $-\frac{1}{4}$ or 4. However, most candidates were successful in finding the correct gradient.

(a)(ii) Most candidates found a correct equation for the line AB but were unable to rearrange it into the given form with integer coefficients. Far too many mistakes are made when candidates rely on using an equation of the form $y = mx + c$ and they may be better advised to remember alternative forms for the equation of a line.

(b) It had been expected that solving a pair of simultaneous equations would have been routine at this level. It was, therefore, quite disappointing to see the number of arithmetic errors preventing many from finding (7, 1) as the point of intersection.

Question 2

(a) Most candidates knew how to differentiate, but a few made careless mistakes when differentiating $3x$ and others insisted on adding $+ C$ to their otherwise correct answer.

(b)(i) Usually sufficient working was shown to verify that the gradient at P was equal to 5.

(b)(ii) Many seemed confused between the tangent and the normal, with many clearly trying to find the equation of the former rather than the latter. The major problem, once again, was rearranging the equation into one involving integer coefficients.

(c) It was clear that some candidates were unfamiliar with the need to consider the sign of $\frac{dy}{dx}$ to determine whether y was increasing or decreasing. It is a pity that $\frac{d^2y}{dx^2}$ also had value –16 when $x = 1$, yet it was surprising to see how many felt they had to consider the sign of the second derivative rather than the first.

Question 3

(a) Most candidates seemed aware of the need to complete the square, but sign errors were very common when finding r^2.

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(b) Provided r^2 was given as a positive value, marks were awarded for following through from their answers to part (a).

(c) Many did not have the stamina to obtain the printed quadratic equation giving the x-coordinates of P and Q. They could usually solve the quadratic equation, but it was very common to see the coordinates of P and Q given as (2, 0) and (3, 0) instead of substituting into the equation $y = x + 4$ to find the correct values of y.

Question 4

(a)(i) Many candidates used long division but very few obtained the correct remainder by this method. In contrast, those who used the Remainder Theorem usually found the correct value of 10 for the remainder.

(a)(ii) Some were confused by the word "factor" and gave answers as 1 and –2.

(a)(iii) Although there were many correct answers given for the factorisation, some candidates appeared to be guessing the factors of f(x), making no use of the information given in part (a)(ii). Despite getting a non-zero remainder for part (a)(i), several candidates gave $(x + 1)$ as a factor.

(b) Most candidates found the coordinates of A, and those with the correct factor $(x - 4)$ of f(x) were usually able to find the correct coordinates of B.

(c) It was pleasing to see most candidates able to integrate correctly, although quite a few failed to integrate 8 to give $8x$. Some candidates did not evaluate the limits in the correct order, but there were many correct values seen for the area of the shaded region.

Question 5

The difference of two squares was often not recognised in part (a). Nevertheless, most were able to multiply out the brackets and, those who realised that $\left(\sqrt{12}\right)^2$ was equal to 12, usually scored full marks for part (a).

Practically everyone knew that $\sqrt{12} = 2\sqrt{3}$ in part (b).

However, the vast majority of candidates failed to express their final answer to part (c) in the required form. Even the most able candidates were content to leave their answer as $2 + \frac{1}{2}\sqrt{12}$.

Question 6

(a) Once candidates realised that the lengths in centimetres of the sides of the box were $24 - 2x$, $9 - 2x$ and x, they were usually able to multiply out to give the printed answer for the volume. A large number of weaker candidates found this part of the question very difficult and made little or no effort to obtain the printed answer. (a)(i) The expression for $\frac{dV}{dx}$ was usually correct.

(a)(ii) This part was answered too casually by many candidates who simply divided their previous answer by 12 and wrote "= 0" to comply with the printed answer. It was necessary to see that the candidate realised that it is necessary for $\frac{dV}{dx} = 0$ for stationary points to occur, before dividing their expression for $\frac{dV}{dx}$ by 12.

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(a)(iii) Most candidates scored the two marks for solving the quadratic equation, although a few who chose to use the formula, rather than factorising, made slips in their arithmetic.

(c) It was pleasing to see that most candidates were able to find a second derivative. However, this was often given as $2x - 11$, since many had previously divided $\frac{\mathrm{d}V}{\mathrm{d}x}$ by 12 and were using this modified expression. Some candidates did not appear to understand the second derivative test for maxima and minima; they wrote things such as "$\frac{\mathrm{d}^2V}{\mathrm{d}x^2} = 24x - 132 = 0$ when $x = 5.5$ and since this is positive the stationary point is a minimum".

Question 7

(a) It was disappointing to see a number of candidates unable to deal with the minus sign outside the second bracket. Another very common error was to simplify the expanded brackets correctly to $-11k^2 - 14k + 25$ and then to say that this was equal to $11k^2 + 14k - 25$, thus losing the accuracy mark.
(b)(i) The sign in the printed answer caused many to write the condition for real roots as $b^2 - 4ac \leqslant 0$. There was a lot of 'fudging' in this part of the question and it was a rare event to see a candidate score full marks.

(b)(ii) The most successful candidates identified the critical values and then used a sign diagram or a sketch to identify the correct solution to the inequality.

MPC2 Pure Core 2

General

In this first examination the overall performance of the candidates was very good with many candidates scoring high marks. There was no evidence to suggest that candidates were rushed to complete the paper and most answered the questions in numerical order.

Candidates should, be aware that when an answer is given in the question they must show sufficient steps in their solution to convince the examiner that they have **obtained** the answer rather than just used it. There was also some evidence to suggest that some candidates may not have been aware that extra formulae, particularly in the series section of the specification, are now provided in the formulae booklet. Candidates should, in general, continue to be encouraged to read the questions carefully and be discouraged from attempting to use trial and improvement to solve equations of the form $a^x = b$. The presentation of solutions was normally excellent. However, it would help if candidates were reminded to complete the question grid on the front page of the answer booklet.

Question 1

Parts (a)(i) and (a)(ii) were generally well answered although it was surprising to find the derivative of x seemingly causing as many problems as the derivative of $\frac{2}{x}$. Although the method for finding the equation of a line was generally well known, a significant minority of candidates found the equation of the tangent rather than the equation of the normal.

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Question 2

With the cosine rule in the formulae booklet, candidates normally used the cosine rule rather than using "$\sin\frac{\theta}{2} = \frac{16}{24}$". Some weaker candidates applied the rule incorrectly as illustrated by "$24^2 = 24^2 + 32^2 - 2\times 24\times 32\cos\theta$". Candidates need to be aware that in order to "show that θ = 1.46 correct to three significant figures", they should have supplied a value for θ to a greater degree of accuracy. The vast majority of candidates found the length of the arc and it was particularly pleasing to see weaker candidates use the printed answer from part (a) to answer part (b). It was surprising to find a significant number of candidates giving the answer for the area of triangle *ABC* rather than the area of sector *ABC* in part (c)(i) and then producing a fully correct solution in part (c)(ii). The formula, $\frac{1}{2}ab\sin C$, for the area of a triangle did not seem to be as well known as it might have been.

Question 3

Part (a) was generally well answered although some tried to use formulae for geometric series rather than arithmetic series. Most were able to find the sum to 20 terms in part (b) although arithmetical errors were noted. Part (c), which involved sigma notation, was not always attempted. The common errors seen otherwise were subtracting S_{21} rather than S_{20} and, normally only produced by the weaker candidates, using the formula for the *n*th term instead of the sum to *n* terms. Some candidates wasted time by showing that the sum to 50 terms was indeed the given value, 11525.

Question 4

Parts (a) and (b) were answered very well and although the powers in answers to part (c) were nearly always correct, the coefficients were sometimes the reciprocal of the powers in part (b). Part (d) caused significantly more problems to the candidates. Although the method of solving a definite integral was well understood, many candidates resorted to using decimal approximations and, in general, candidates displayed a weakness in converting fractional powers of numbers back into surds.

Question 5

In part (a), some candidates did not provide sufficient steps to justify stating the printed value for *x*. The most common error was illustrated by "$\log_a 216 - \log_a 8 = \frac{\log_a 216}{\log_a 8}$". Most candidates gained significant credit in part (b), although part (b)(iv) did provide some challenge.

Question 6

Use of the binomial expansion and use of the expansion of $(2 + x)(2 + x)^2$ were equally popular in part (a)(i) and most obtained the correct answer. There was however a minority of candidates who did not include the powers of 2 in the middle terms when applying the binomial expansion. It was disappointing to see so many candidates producing masses of algebra rather than replacing *x* by (–*x*) to obtain the answer to part (a)(ii). There was some evidence of 'faking' to reach the printed answer in part (b), which quite often resulted in marks being lost as earlier correct work was changed. The vast majority realised that $\frac{dy}{dx}$ was required in part (c), although some later explanations could have been more precise.

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Question 7

In part (a), the question asked for the coordinates of the marked points on the trigonometrical graph. For each point, examiners expected to be given both coordinates rather than just a non-zero value. Other common errors included answers involving radians and also answers which had the x- and y-coordinates switched. In part (b), candidates were expected to use the word "stretch" and also to give the direction and scale factor of the stretch. As expected, a scale factor of 2 rather than $\frac{1}{2}$ was the usual error. Relatively few candidates gained all the available marks in part (c). Most obtained two of the four values, but many missed the value from ' $x = 180 + 180 - \frac{\alpha}{2}$ '. Candidates should also be aware that when asked to give answers to the nearest 0.1°, their earlier working should be done to a greater degree of accuracy. Failure to do this frequently lead to the wrong answer "214.2°".

Question 8

Many candidates incorrectly evaluated (3^0 + 1) as 1 in part (a) although surprisingly they frequently recovered and used the correct answer, 2, in part (b). In general, the trapezium rule was well understood, although it was relatively common to find an arithmetical slip in evaluating (3^x + 1); the '1' was not added in one of the terms. Candidates should have given the final answer to the degree of accuracy specified in this numerical integration question. Some of the weaker candidates just integrated (3^x + 1) directly as (3^{x+1} + x). The use of a diagram to show that the approximation is an overestimate was well understood, although some used rectangles rather than the required trapeziums and others had the sloping sides of their trapeziums in the wrong positions, that is, below the curve. Part (c) was generally well answered although some weaker candidates tried to take logarithms of each term rather than to rearrange the equation into the form '$3^x = 4$' as a first step. Those candidates who used trial and improvement usually failed to produce an acceptable solution. In part (d), a common wrong expression for f(x) was "$-3^x + 1$", although a significant minority did obtain the correct answer "$3^{-x} + 1$".

MFP1 Further Pure 1

General

The candidates showed a very impressive grasp of the knowledge and techniques needed for this paper. There was only a small proportion of candidates who did not seem to be adequately prepared for the paper. The best-answered question was Question 7, which produced full marks for the majority of candidates. Other questions which proved straightforward for most candidates were Question 1, Question 3 and the first two parts of Question 5. Question 2(a) was also found quite easy but the later parts of this question provided a slightly stiffer challenge. Question 4 caused many candidates to struggle, but not without a reasonable reward for their efforts. Further difficulties came in Question 5(c), Question 6 and the middle two parts of Question 8. For many candidates the only substantial loss of marks came in Question 9, where the ideas and techniques were more advanced and it is possible that some candidates were having to hurry their work as time ran out.

Question 1

This question allowed most candidates to make a good confident start to the paper. Occasionally the values of $\alpha + \beta$ and $\alpha\beta$ were interchanged or one of them had the wrong sign. More seriously, in part (c), some candidates equated $(\alpha\beta)^3$ with $(\alpha + \beta)^3$ and often felt it necessary to expand $(\alpha + \beta)^3$, causing them a considerable loss of time. The mark scheme had only one mark for putting together the final

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equation. Hence, the distressingly common mistake of omitting the "= 0" at the end was not penalised on this occasion.

Question 2

Part (a) was usually answered correctly, although some candidates seemed to spend more time on it than they would have had if they had been more familiar with the context. Weaker candidates struggled with the algebra in part (b), but the more confident ones missed the significance of the plurals in the wording of the question and found only one y-coordinate. Most candidates wrote down their answers in part (c) as required, often correctly but sometimes with an extraordinary variety of errors.

Question 3

Many candidates showed a sufficient familiarity with complex numbers to pick up a fair number of marks in this question. Part (a) was almost always correct, but a sign error spoiled many answers to part (b). Many candidates did not clearly state the real and imaginary parts in part (b), or stated the imaginary part as the correct answer multiplied by i, but these faults were condoned if, as usually happened, the candidate used the real and imaginary parts correctly in part (c).

Question 4

Many answers to this question were spoiled by poor integration. However, many candidates were still as able to show some understanding of the significance of the negative power of x tending to zero as x tended to infinity. Answers to part (b) tended to be vague, but credit was given if the candidate had an x term not present in part (a) and then stated that the integral had no finite value. In part (c), many candidates revealed their lack of experience of integration by simply integrating both factors and multiplying the results.

Question 5

The responses to parts (a) and (b) of this question were most impressive, showing that a good majority of candidates were familiar with matrices of simple transformations. Unfortunately, there were relatively few candidates who knew which way round to multiply the matrices in part (c). Even very strong candidates often went wrong here.

Question 6

There was a far less impressive response to this question. Most candidates knew something about general solutions of trigonometric equations, about the need for a $2n\pi$ somewhere, about the need for a plus-or-minus somewhere, and about the need to solve an equation of the form $2x + \frac{\pi}{6} = k$. But these pieces of knowledge were applied in a rather haphazard and illogical way to the problem before them, and in part (b), they showed very little understanding of the multiple solutions of trigonometric equations.

Question 7

The candidates showed a high degree of accuracy in carrying out the tasks set before them in this question. Mistakes in plotting were very rare and not serious enough to prevent the candidates from continuing with part (b). Errors occurring in part (b), again only rarely, were a failure to show any working for the gradient of the line, and a failure to identify the gradient and the intercept with a and b respectively. Some candidates used longer methods than reading off the intercept, but still found a value for a legitimately.

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Question 8

Most candidates were able to differentiate f(x) correctly and to apply the Newton-Raphson method correctly in parts (a) and (d). Part (b) tested their understanding of the method and was not nearly as well done. Part (c) was only rarely done properly; many candidates using the magnitudes of the values of f(x) rather than their signs to supply evidence for the proposition put before them.

Question 9

Part (a) was generally well answered, although the equation $y = 0$ was often given instead of $y = 1$ for the horizontal asymptote. Attempts at part (b)(i) were often inconclusive, but part (b)(ii) was often well attempted despite errors in simplifying the expression $\frac{-2 \pm \sqrt{-4}}{2}$. Part (c) was only seriously attempted by stronger candidates, of whom many produced concise accurate solutions in both parts. No credit was given for attempts to use differentiation to find the stationary point.

MS1A/W Statistics 1A/W

General

For this first paper set on the new specification, the overall level of performance was very good. There were some centres where most, if not all, candidates scored high marks whilst the performance of candidates from other centres was more varied. Nevertheless, a minimum mark of 11 and a maximum mark of 58, out of 60, speak volumes for the overall performance of candidates on this paper.

Almost all candidates appeared to make use of the new **blue** booklet for formulae, binomial probabilities, normal probabilities and z-values, but some misunderstood formulae or values tabulated. However, even the most able candidates tended to drop some marks in the interpretation and explanation parts of questions.

Candidates are encouraged to use the statistical functions on their calculators. Those candidates that did saved time and were generally more successful than those who attempted calculations using formulae for the few marks available. However, all candidates should be aware of the instruction that **final answers should be given to three significant figures**. Some candidates, either using statistical functions on their calculators or using formulae, lost valuable marks by simply quoting answers to fewer significant figures. Centres are strongly advised to promote the concept of quoting answers to (at least) three significant figures before the next sitting of this paper.

Question 1

Fewer candidates than expected gained full marks in this question, usually due to a lack of precision in answers to part (a) and/or part (d).

In part (a), many candidates commented on a correlation between temperature and sales, although they were not always sufficiently specific to gain the mark. Adjectives such as 'weak positive' or descriptions suggesting 'a slight increase' were expected. Recognition of anomalies needed to be clear; mere statements of maximums, minimums or ranges of values, that could be obtained from the table, were not sufficient.

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In part (b), most candidates correctly identified Monday 10. By far the most common error was stating Monday 4; candidates perhaps confused between Monday 4 and the 4ºC from Monday 10?

In part (c), candidates using the statistical functions available on their calculators were generally correct, any errors usually being attributable to not deleting a Monday or deleting the wrong Monday from part (b). However, such candidates still received some method marks. This was not the case when answers were simply quoted to less than three significant figures. Of the significant minority of candidates who used formulae, some were completely correct, but many others demonstrated a lack of accuracy or understanding of the formulae involved, with the result that non-sensible answers were sometimes the end result.

In part (d), 'weather' was not sufficient since the question had suggested temperature as a variable affecting the sales. Many other alternatives were acceptable though 'rain' was by far the most common valid answer.

Question 2

Answers to this straightforward question were generally poor with many candidates scoring no marks. There was about a 50:50 split between those candidates using functions on their calculators and those using formulae. Common errors were to ignore the frequencies and so opt for $n = 9$, interchange frequencies (f) and values (x) or calculate $\sum(fx)^2$ instead of $\sum fx^2$.

Question 3

For well-prepared candidates, this was a straightforward question, testing techniques that feature on the comparable papers in the legacy Specifications A and B and, as a result, they scored well.

Most candidates answered part (a)(i) correctly, with very few attempting to introduce a 'correction factor'. However, in part (a)(ii), a small minority of candidates standardised 99.5 or 99 and then these and some other candidates failed to conduct the necessary area change. Most candidates used the tables provided rather than any normal probability facility on their calculators.

In part (b), the success rate by candidates was again high. However, there was again a tendency for a small minority of candidates to use 99.5 or 99, rather than 100, in their standardisation. The only other significant error made was the use of a positive, instead of a negative, z-value.

Question 4

At least 8 marks were frequently achieved on this question with the better candidates scoring full marks. In part (a), all candidates were able to plot accurately most, if not all, of the points on the scatter diagram. In part (b), candidates using the statistical functions on their calculators were generally accurate in finding values for a and b, although a few subsequently interchanged the meaning of the two values found. Candidates using the statistical functions on their calculators usually calculated and plotted two points accurately and then joined them by a straight line to obtain full marks. Candidates attempting to calculate a and b from formulae rarely made errors in their application but did tend to introduce computational errors. In part (c), it was very pleasing to see the many correct interpretations, particularly of a, but some statements failed to identify that b represented the (average) time to deliver one parcel.

Question 5

Many candidates scored full marks in part (a). A small minority of candidates used an incorrect z-value or omitted the divisor $\sqrt{n}$. In part (b)(i), it was rare to see an answer scoring both marks. Whilst there was invariably some reference to the size of the standard deviation, very few candidates linked this to the

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size of the mean and hence to likely negative values. Most candidates scored the mark in part (b)(ii) for phrases such as 'n large' or 'Central Limit Theorem'. However, in part (b)(iii), many candidates scored few, if any, marks through standardising 60 using 53 and 42 instead of 53 and $\frac{42}{\sqrt{60}}$. Perhaps candidates need to be made more aware of the distribution of the sample mean?

Question 6

Answers to part (a)(i), obtained directly from the cumulative binomial tables, were usually correct. Part (a)(ii) caused many candidates all sorts of difficulties. Whilst most candidates tried to use the aforementioned tables, many could not deal correctly with both inequalities. Thus $P(X \le 10)$ was often used instead of $P(X \le 9)$ and/or $P(X \le 4)$ instead of $P(X \le 5)$. The alternative method of using binomial formulae usually involved correct expressions but some candidates then failed to obtain a sufficiently accurate answer. Again in part (b), binomial expressions were generally correct. A small number of candidates used $n = 7$ instead of 28 or $p = 0.2$ (0.5×0.4) instead of 0.4, whilst others gave an answer to less than three significant figures. It was pleasing to see many candidates scoring the mark in part (c) for indicating that days per month vary.

Question 7

Somewhat surprisingly perhaps, this was another good source of marks for many candidates. Answers to parts (a)(i) and (a)(ii) were invariably correct. Part (a)(iii), involving conditional probability, was less successfully answered, usually as a result of attempting to work with the formula $\frac{P(F \cap A)}{P(A)}$, rather than making direct reference to the table. In part (b), a few candidates based their calculation on replacement but could receive credit if identifying that there were three possible combinations of *MFF*. Unfortunately, a number of candidates thought there was either 1 or 3! such combinations. Otherwise, many candidates were successful. Answers to part (c) suggested that most candidates appeared to have a sound knowledge of set notation. Whilst most candidates scored the mark in part (c)(i), a number of them lost a mark in part (ii), usually for the use of 'not female' or the addition of 'but not both'. A very small minority did not answer the questions as set but merely gave probabilities as their answers.

MS1B Statistics 1B

General

For this first paper set on the new specification, the overall level of performance was very satisfactory and in line with that seen of late on comparative papers on the legacy Specifications A and B. However, of some concern was the number of (large) centres whose entire entry scored low marks. Evidence from their candidates' scripts suggested that important sections of this specification had simply not been covered in the time available. Elsewhere, there were some (smaller) centres where most, if not all, candidates scored high marks. As a result marks were seen almost across the full range from 0 to 75.

Almost all candidates appeared to make use of the new **blue** booklet for formulae, binomial probabilities, normal probabilities and *z*-values, but some misunderstood formulae or values tabulated. However, even the most able candidates tended to drop marks in the interpretation and explanation parts of questions. In particular, very few candidates were prepared to commit to a decision in Question 2(b) or in Question 5(d)(ii).

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Candidates are encouraged to use the statistical functions on their calculators. Those candidates that did saved time and were generally more successful than those who attempted calculations using formulae for the few marks available. However, all candidates should be aware of the instruction that **final answers should be given to three significant figures**. Far too many candidates, either using statistical functions on their calculators or using formulae, lost valuable marks by simply quoting answers to fewer significant figures. From statements on their scripts, a number of candidates were clearly under the mistaken impression that, for example, 0.82 was three significant figures. Centres are strongly advised to promote the concept of quoting answers to (at least) three significant figures before the next sitting of the paper.

Question 1

Fewer candidates than expected gained full marks in this question, usually due to a lack of precision in answers to part (a) and/or part (d). A number of centres had clearly not yet taught the product moment correlation coefficient.

In part (a), many candidates commented on a correlation between temperature and sales, although they were not always sufficiently specific to gain the mark. Adjectives such as 'weak positive' or descriptions suggesting 'a slight increase' were expected. Recognition of anomalies needed to be clear; mere statements of maximums, minimums or ranges of values, that could be obtained from the table, were not sufficient.

In part (b), most candidates correctly identified Monday 10. By far the most common error was stating Monday 4; candidates perhaps being confused between Monday 4 and the 4ºC from Monday 10?

In part (c), candidates using the statistical functions available on their calculators were generally correct, any errors usually being attributable to not deleting a Monday or deleting the wrong Monday from part (b). However such candidates still received some method marks. This was not the case when answers were simply quoted to less than three significant figures. Of the significant minority of candidates who used formulae, some were completely correct, but many others demonstrated a lack of accuracy or understanding of the formulae involved with the result that non-sensible answers were the end result.

In part (d), 'weather' was not sufficient since the question had suggested temperature as a variable affecting the sales. Many other alternatives were acceptable though 'rain' was by far the most common valid answer.

Question 2

Many candidates appeared ill-prepared for this type of routine question. As a result, in part (a) the success rate on the straightforward confidence interval calculation was disappointing. Most candidates found the correct value for the sample mean but some candidates used a z-value of 2.0537, rather than 2.3263, whilst others omitted the divisor $\sqrt{12}$ or used the sample standard deviation instead of the given value of 3.5. However, in general, well-prepared candidates scored all 5 marks.

In answering part (b), most candidates paid no heed to the fact that 3 marks were available and so opted for general subjective assumptions that usually scored no marks. Thus few candidates made use of their calculated confidence interval and even less gave a correct interpretation of it. There was also minimal reference to the sample data. As a result, even the best candidates, who recognised the relevance of both the sample data and their confidence interval, were reluctant to commit to a conclusion.

Somewhat surprisingly, it was rare indeed to see a correct answer to part (c). Most candidates presumed incorrectly that since use of the Central Limit Theorem was justified via 'a sufficiently large sample size', the scenario described in the question did not require its use because the sample size was 'small'. Some of the few candidates recognising the idea of a normal population still lacked sufficient precision in their description; statements involving "it" or "the sample" were common but not acceptable.

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Question 3

At least 8 marks were frequently achieved on this question with the better candidates scoring at least 12 marks. In fact, many of the weakest candidates scored the majority of their marks on this question.

In part (a), all candidates were able to make an attempt at plotting the points on the scatter diagram. Difficulties with the horizontal scale appeared to cause most of the problems.

In part (b), candidates using the statistical functions on their calculators were generally accurate in finding values for a and b, although a few subsequently interchanged the meaning of the two values found. Candidates using the statistical functions on their calculators usually calculated and plotted two points accurately and then joined them by a straight line to obtain full marks. Candidates attempting to calculate a and b from formulae often made errors in their application; for example, $\sum x - \bar{x}$ rather than $\sum(x - \bar{x})$, and $\sum x \sum y$ rather than $\sum xy$.

Although correct estimates were often obtained in part (c), comments on their reliability were sometimes disappointing. Good candidates did refer to interpolation and extrapolation or the fact that 35 parcels was outside the range of the given data, but many other responses referred to difficulties encountered in reading their graphs and the various invalid techniques they had adopted to overcome this. A surprising number of candidates believed their estimates for 35 parcels were reliable because they had substituted 35 into their regression equation and evaluated the expression with a calculator.

In part (d), there were many correct interpretations, particularly of a, but too many statements failed to identify that b represented the (average) time to deliver one parcel. Weaker candidates tended to restate the information given in the question or simply quote "gradient and intercept". A few candidates, who had not scored marks in part (b), received retrospective credit if they stated values for a and b in this part.

Question 4

This was another routine question that was poorly answered by a significant number of candidates. Often these candidates made no real attempt at any part of the question. For well-prepared candidates, this was a straightforward question, testing techniques that feature on the comparable papers in the legacy specifications and, as a result, they scored well.

Most candidates making an attempt at part (a)(i) were successful. However, a surprising number of candidates failed to answer part (a)(ii) correctly; standardising 99 or even 106 was quite common and then these and some other candidates failed to conduct the necessary area change. Most candidates used the tables provided rather than any normal probability facility on their calculators.

In part (b), the success rate by some candidates was high, but again there was a tendency for candidates to use 106 rather than 100 in their standardisation. For those making progress, the usual other error was an incorrect z-value. Some candidates did not show a clear method and they should be advised to show a standardisation equated to a z-value, or equivalent, before attempting any rearrangement.

In part (c)(i), many candidates gained the mark for the mean, with 10.85 or 1085 seen from the weakest candidates. Very few correct variances were seen; a few candidates gave the standard deviation of $\bar{X}$ but many more gave the variance of X rather than $\bar{X}$. Despite these errors, a surprising number of these candidates recovered and, together with able candidates, answered part (c)(ii) correctly.

Question 5

Parts (a) and (b) were considered to be routine tasks and it was disappointing to see that some candidates appeared unable to make any attempt.

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Answers to part (a)(i) were usually correct, although a small minority used $p = 0.04$, rather than 0.4, in the cumulative binomial tables. Part (a)(ii), caused candidates all sorts of difficulties. Whilst most candidates tried to use the aforementioned tables, many could not deal correctly with both inequalities. Thus $P(X \leq 5)$ was often used instead of $P(X \leq 4)$ and, although many candidates found $P(X \leq 1)$ correctly, they then used this to find $P(X > 1)$ and subsequently $P(X \leq 5) - P(X > 1)$ as their final answer. The alternative method of using binomial formulae usually involved correct expressions but many candidates failed to evaluate them correctly.

Again, in part (b), binomial expressions were generally correct, although some candidates used $n = 7$, instead of 28, whilst others gave an answer to less than three significant figures.

Surprisingly, many candidates omitted part (c), this despite the specific reference to the topic in the Specification and the provision of relevant formulae in the supplied booklet. Some candidates, using the formulae, gave the value of the variance rather than the required standard deviation. Other candidates were able to intuitively state the mean correctly without explicit knowledge of its formula.

In part (d)(i), some candidates ignored the frequencies. Otherwise, most candidates used the statistical functions on their calculators with most obtaining both the mean and standard deviation correctly, although a minority reversed values and frequencies. The few candidates who had a complete set of answers to parts (c) and (d)(i) for comparison, were generally reluctant to commit to a conclusion and were often confused in their interpretations. Some candidates who failed to answer part (c) essentially made use of mean = np by showing that their mean in part (d)(i) when divided by 7 gave the stated probability of 0.4.

Question 6

Somewhat surprisingly perhaps, this was another good source of marks for weaker candidates.

Answers to parts (a)(i), (ii) and (iv) were often correct. Part (a)(iii) was less successfully answered, usually as a result of the duplication of $P(F \cap A)$ in the calculation.

In part (b)(i), some calculations were based on replacement and so were invalid methods. There was an alarming number of answers greater than 1, candidates having summed their individual probabilities instead of multiplying. However, overall, the success rate was good. Again in part (b)(ii), a few candidates based their calculation on replacement but could receive credit if identifying that there were three possible combinations of *MFF*. Unfortunately, a sizeable number of candidates thought there was either 1 or 3! such combinations. Otherwise, many candidates were successful.

Answers to part (d) were much less impressive. Although most candidates appeared to have some knowledge of set notation, it was not unusual to see the meanings of $\cap$ and $\cup$ sometimes being swapped or to see $F' \cup A$ interpreted as $A \mid F$. A number of candidates did not answer the questions as set, but merely gave probabilities as their answers or statements such as "*F* intersected with *A*". Candidates must expect to relate, as directed, to the context of the question. Use of "not female" was also not sufficient in this context.

MM1A/W Mechanics 1A/W

General

There was a very small entry for this paper in this series, which was the first time that it had been offered. The paper proved to be accessible to most candidates. There was a few candidates who did not show enough working to support their solutions to “show that” questions.

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Question 1

Most candidates did well on this question; almost were able to obtain the acceleration without difficulty. Finding the distance was also done well, but a few candidates made arithmetic errors. There was also a small number who assumed a constant velocity. Part (b) caused a few more problems. Some candidates had trouble with the units and did not convert tonnes to kg. A few also made sign errors, while some others simply calculated the product of the mass and acceleration.

Question 2

Candidates produced many good solutions to this question. Most of the errors that were found were due to poor arithmetic or sign errors. A few candidates omitted the mass from one or more of the terms and occasionally a candidate would use weight instead of mass.

Question 3

There was a good number of correct force diagrams. Some candidates added one or both of the components of the tension to their force diagram. In some cases these appeared as if they were additional forces. Parts (b) and (c) were done well by most candidates who seemed to have benefitted from the printed answers. There were some candidates who did not gain full marks, because they did not show sufficient working. In part (d), many candidates obtained the correct value. Some candidates used the two printed answers as expected, if they had not been able to obtain the two values for themselves. There were some very good answers to part (e), but there were also quite a few confused ones as well, with many candidates finding it hard to give a good answer.

Question 4

Candidates found part (a) quite straightforward, although some did omit g from their calculations. Part (b) was done well by some candidates, but some of the weaker candidates used the weight of the 8kg particle rather than the tension when forming an equation to find its acceleration.

Question 5

Part (a) of this question was done well by several candidates, while part (b) was found to be more demanding. In part (a), the candidates seemed to have been helped by the printed answer. In part (b), the major problem was setting up an appropriate equation to find the time of flight. Those who could do this generally went on to complete the question correctly. One issue that was evident was that a small number of candidates did not resolve the velocity into components, but simply worked with 30 wherever they needed a velocity.

Question 6

Overall, the candidates found this question quite demanding. Each part of this question tended to be answered either very well or very badly, with very little middle ground. Those who could identify the correct triangle to work in and apply the sine or cosine rule encountered very few problems. Other candidates either made no real attempt or could not identify a suitable approach. Some candidates who were unable to do part (a) used the printed answer to compete part (b). Quite a number of candidates scored no marks on this question.

Question 7

Candidates found this question quite demanding. Candidates were most successful with part (a) and for some this was the only place where they gained marks. In part (b), many candidates omitted the initial position of the yacht, and a number tried to integrate the initial velocity. In part (c)(i), a poor answer for the position vector had an impact. However, some candidates who had good expressions simply showed

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that the **i** component of the position was zero and not that the yacht was due north of the origin. In part (c)(ii), quite a few candidates found the velocity correctly, but did not go on to find the speed.

MM1B Mechanics 1B

General

There was a good sized entry for this paper in this first series. The paper proved to be accessible to most candidates. There were very few weak scripts and a good number demonstrated a high level of understanding and competence. There were a few candidates who did not show enough working to support their solutions to "show that" questions.

Question 1

Most candidates did well on this question; almost all were able to obtain the acceleration without difficulty. Finding the distance was also done well, but a few candidates made arithmetic errors. There was also a small number who assumed a constant velocity. Part (b) caused a few more problems. Some candidates had trouble with the units and did not convert tonnes to kg. A few also made sign errors, while some others simply calculated the product of the mass and acceleration.

Question 2

Candidates produced many good solutions to this question. Most of the errors that were found were due to poor arithmetic or sign errors. A few candidates omitted the mass from one or more of the terms and occasionally a candidate would use weight instead of mass.

Question 3

There was a good number of correct force diagrams. Some candidates added one or both of the components of the tension to their force diagram. In some cases these appeared as if they were additional forces. Parts (b) and (c) were done well by most candidates who seemed to have benefitted from the printed answers as expected. There were some candidates who did not gain full marks, because they did not show sufficient working. In part (d), many candidates obtained the correct value. Some candidates used the two printed answers as expected, if they had not been able to obtain the two values for themselves. There were some very good answers to part (e), but there were also quite a few confused ones as well, with many candidates finding it hard to give a good answer.

Question 4

In part (a), a number of candidates made assumptions about the particles instead of the pulley. Part (b) was generally done very well, but some candidates ignored the instruction to form equations of motion for each particle; these candidates were penalised. Most candidates were able to find the tension.

Question 5

As a whole candidates seemed to find this question more demanding. While some made good attempts there were a number of candidates that showed weaknesses in resolving or that did not recognise that resolving was required. In part (b), there was a number of candidates who omitted the weight from their solutions, simply summing the vertical components of the two tensions.

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Question 6

Overall, the candidates found this question quite demanding. Each part of this question tended to be answered either very well or very badly, with very little middle ground. Those who could identify the correct triangle to work in and apply the sine or cosine rule encountered very few problems. Other candidates either made no real attempt or could not identify a suitable approach. Some candidates who were unable to do part (a) used the printed answer to compete part (b). Quite a number of candidates scored no marks on this question.

Question 7

Candidates found this question quite demanding. Candidates were most successful with part (a) and for some this was the only place where they gained marks. In part (b), many candidates omitted the initial position of the yacht and a number tried to integrate the initial velocity. In part (c)(i), a poor answer for the position vector had an impact. However, some candidates who had good expressions simply showed that the **i** component of the position was zero and not that the yacht was due north of the origin. In part (c)(ii), quite a few candidates found the velocity correctly, but did not go on to find the speed.

Question 8

Part (a) was generally answered well. There were however some curious assumptions, for example "the ball has no mass", which were not appropriate. Part (b) was generally done quite well, with candidates obtaining the results without too much difficulty. Part (c) proved to be more demanding, but candidates often tended to do very badly or very well. If they could produce a correct equation for t they could often gain all the marks, but other candidates could not see how to form an equation that would enable them to start the question. In a few cases the candidates rounded the time of flight and then obtained an incorrect value for the range.

MD01 Decision 1

General

There was a large number of candidates taking this examination and overall the candidates were well prepared for the demands of the paper with very few very weak scripts. The candidates presented their work well with clear diagrams shown. Some candidates found the scale diagram awkward to cope with in Question 8 and a few candidates rubbed out their working on Dijkstra's algorithm in Question 6.

Question 1

This question was well answered with the majority of candidates scoring full marks. A few candidates were able to correctly produce the trace table but then made simple computational mistakes.

Question 2

Part (a) of this question was well answered. However, a number of candidates showed the arrangement after each comparison rather than after each pass, as required in the question. These candidates were not penalised apart from the demands on their time. The majority of candidates were able to score both marks on part (b), although there were more mistakes in the number of swaps.

Question 3

Nearly all candidates were able to answer part (a) correctly. In part (b), candidates must realise that for a Chinese postman problem involving 4 odd vertices, they have to show the 3 pairings **and** justify that they

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have selected the optimum pairing. A number of candidates thought that the sum of the 3 pairings was the same and that any pairing could be chosen. Some candidates who correctly chose the correct pairing to repeat failed to find a corresponding route. Candidates are encouraged to list the orders of the vertices after the repeats have been included. They would then be able to check if they had a correct route corresponding to their minimum distance.

Question 4

Part (a) was well answered with virtually everyone gaining full marks. Part (b) was usually well answered, although some candidates did not show their path clearly or did multiple paths on the same diagram. Candidates are **strongly** advised to write down their alternating path in addition to showing the path on their bipartite graph.

Question 5

This question was a good source of marks for the majority of candidates. There was a number of candidates who drew a spanning tree in part (c) without labelling their tree. In part (d), candidates were expected to use their previous working to find required edges. However, a large number of candidates started from scratch and applied Kruskal's algorithm to the network.

Question 6

All candidates were able to score on this question. Dijkstra's algorithm was correctly used in part (a) by the majority of students. Candidates **must** clearly show their working at each vertex. Only the better candidates were able to correctly answer part (b), with many candidates being unsure as to whether or not to use strict inequalities.

Question 7

Candidates scored well on both parts of (a). A small number of candidates do not return to the start vertex when applying the nearest neighbour algorithm. Part (b) discriminated between the candidates with only the better scoring full marks. Centres should note that a lower bound is a minimum spanning tree + the shortest two edges from the deleted vertex. It is not allowable to use twice the shortest edge. A significant number of candidates failed to score the mark in part (c) as they wrote their answer as a strict inequality. The fundamental principles of upper and lower bounds are still not appreciated.

Question 8

All candidates were able to score on this question. Parts (a) and (b) were well answered. Many candidates were unable to handle the difference in the scales on the axes and a large number of candidates failed to produce a correct objective line. There were very few candidates that were able to answer part (e) correctly; this proved to be a good discriminator for the grade A candidates. The popular wrong answer for part (e)(ii) was 160.

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Coursework

General

This was the first time that centres had the opportunity to enter candidates for the coursework option under the new specifications introduced in September 2004. At this point in time there were entries only at AS level for MM1A/C and MS/SS1A/C. It may be that the population for this first series may not prove to be typical of January cohorts as the number of entries was small and the sample moderated was therefore correspondingly small. The following comments are based on the few scripts seen, and must be interpreted in that context.

Centres had complied with AQA requirements to annotate scripts and to show evidence of checking of each type of calculation and to highlight errors. This was helpful to the moderation process as it aids understanding of how marks awarded have been allocated. The standard of work seen was pleasing on the whole with candidates showing good understanding of the tasks set and working to the level of demand necessary. Very few scripts contained unnecessary work and almost all were of a sensible length.

Candidates have clearly been encouraged to address all of the criteria across all four strands. Many candidates had successfully included relevant practical work and had quoted from other researched sources of information to aid their investigation and to place their mathematics in context. The use of spreadsheets has been recognised as important in reducing the need for repetitive numerical work and therefore allowing time for further investigation by changing the values of variables and considering their effects. However it is important that candidates explain/derive the formulae used and check that they are accurate through the use of specific examples.

Mechanics

Arctic Research and *Designing a Children's Slide* proved to be the most popular tasks. There were many correct and appropriate calculations based on a good understanding of mechanical principles, together with details of experiments and tables of results. Graphs should be drawn to aid interpretation and prediction. Candidates are encouraged to check their mathematical model for realism by comparison with 'real-life' data, if appropriate. They should consider the effects of all their assumptions on the outcomes and suggest modifications. **Please note that scale diagrams are not a part of the specification for MM1A and do not allow candidates to gain credit.**

Statistics

The work seen was generally of a good standard with a range of interesting individual responses to the tasks set. The new task on correlation and regression proved to be successful and was used by a number of centres. Many candidates showed sound understanding of the content of the unit; in particular statistical theory was threaded through at appropriate points by the best candidates. Ample data was collected and there were many correct and appropriate calculations. Diagrams helped with the interpretation of the overlap or not of confidence intervals and most candidates appropriately used more than one level of confidence. This is still an area, though, that most candidates find hard to analyse and guidance and explanation by the centres are needed. Candidates should also be encouraged to explain in careful detail how their sample was collected and how it is random and representative. Good use, for sampling purposes, can be made of secondary data found on the internet.

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Mark Ranges and Award of Grades

Unit/Component	Maximum Mark (Raw)	Maximum Mark (Scaled)	Mean Mark (Scaled)	Standard Deviation (Scaled)
MPC1: Pure Core 1	75	75	51.3	16.2
MPC2: Pure Core 2	75	75	58.1	17.7
MFP1: Further Pure 1	75	75	49.3	17.3
MS1A/W: Statistics 1A (Written)	60	75	44.4	14.0
MS1A/C: Statistics 1A (Coursework)	80	25	18.5	3.8
MS1A: Statistics 1A	--	100	63.0	16.0
MS1B: Statistics 1B	75	75	42.1	15.1
MM1A/W: Mechanics 1A (Written)	60	75	44.1	18.3
MM1A/C: Mechanics 1A (Coursework)	80	25	16.1	3.3
MM1A: Mechanics 1A	--	100	60.4	20.2
MM1B: Mechanics 1B	75	75	52.3	17.5
MD01: Decision 1	75	75	53.9	13.6

Unit MPC1: Pure Core 1 (7142 candidates)

Grade	Max. mark	A	B	C	D	E
Scaled Boundary Mark	75	59	52	45	39	33
Uniform Boundary Mark	100	80	70	60	50	40

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Unit MPC2: Pure Core 2 (267 candidates)

Grade	Max. mark	A	B	C	D	E
Scaled Boundary Mark	75	60	52	45	38	31
Uniform Boundary Mark	100	80	70	60	50	40

Unit MFP1: Further Pure 1 (251 candidates)

Grade	Max. mark	A	B	C	D	E
Scaled Boundary Mark	75	59	52	45	38	32
Uniform Boundary Mark	100	80	70	60	50	40

Unit MS1A: Statistics 1A (127 candidates)*

		Max. mark	A	B	C	D	E
Written Boundary Mark	raw	60	46	40	34	28	23
	scaled	75	58	50	43	35	29
Coursework Boundary Mark	raw	80	64	56	48	40	32
	scaled	25	20	18	15	13	10
Unit Scaled Boundary Mark		100	78	68	58	48	39
Uniform Boundary Mark		100	80	70	60	50	40

MS1B: Statistics 1B (927 candidates)*

Grade	Max. mark	A	B	C	D	E
Scaled Boundary Mark	75	58	50	43	36	29
Uniform Boundary Mark	100	80	70	60	50	40

* **Note**: with the exception of the numbers of candidates graded, all information in this section relates to the **combined** units MS/SS1A and MS/SS1B.

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Unit MM1A: Mechanics 1A (39 candidates)

		Max. mark	A	B	C	D	E
Written Boundary Mark	raw	60	47	40	34	28	22
	scaled	75	59	50	43	35	28
Coursework Boundary Mark	raw	80	64	56	48	40	32
	scaled	25	20	18	15	13	10
Unit Scaled Boundary Mark		100	79	68	58	48	38
Uniform Boundary Mark		100	80	70	60	50	40

Unit MM1B: Mechanics 1B (435 candidates)

Grade	Max. mark	A	B	C	D	E
Scaled Boundary Mark	75	59	51	43	35	27
Uniform Boundary Mark	100	80	70	60	50	40

Unit MD01: Decision 1 (1610 candidates)

Grade	Max. mark	A	B	C	D	E
Scaled Boundary Mark	75	61	54	47	41	35
Uniform Boundary Mark	100	80	70	60	50	40

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Advanced Subsidiary awards

Mathematics

Provisional statistics for the award (4 candidates)

	A	B	C	D	E
Cumulative %	25.0	50.0	50.0	75.0	75.0

Pure Mathematics

Provisional statistics for the award (0 candidates)

Further Mathematics

Provisional statistics for the award (0 candidates)

Definitions

Boundary Mark: the minimum mark required by a candidate to qualify for a given grade.

Mean Mark: is the sum of all candidates' marks divided by the number of candidates. In order to compare mean marks for different components, the mean mark (scaled) should be expressed as a percentage of the maximum mark (scaled).

Standard Deviation: a measure of the spread of candidates' marks. In most components, approximately two-thirds of all candidates lie in a range of plus or minus one standard deviation from the mean, and approximately 95% of all candidates lie in a range of plus or minus two standard deviations from the mean. In order to compare the standard deviations for different components, the standard deviation (scaled) should be expressed as a percentage of the maximum mark (scaled).

Uniform Mark: a score on a standard scale which indicates a candidate's performance. The lowest uniform mark for grade A is always 80% of the maximum uniform mark for the unit, similarly grade B is 70%, grade C is 60%, grade D is 50% and grade E is 40%. A candidate's total scaled mark for each unit is converted to a uniform mark and the uniform marks for the units which count towards the AS or A-level qualification are added in order to determine the candidate's overall grade.

Further information on how a candidate's raw marks are converted to uniform marks can be found in the AQA booklet *Uniform Marks in GCE, VCE, GNVQ and GCSE Examinations*.

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