GCE EXAMINERS' REPORTS

MATHEMATICS M1-M3 & S1-S3
AS/Advanced

SUMMER 2016

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MATHEMATICS

General Certificate of Education

Summer 2016

Advanced Subsidiary/Advanced

M1

General comments

This paper turned out to be very accessible to most candidates. Only question 7 and 8 posed any difficulties.

Comments on individual questions

1. This question gave the candidate a good start to the paper. There were the occasional sign errors when candidates were either unsure or confused as to which direction they were taking as positive.

2. Part (a) was a standard question that appeared in previous papers numerous times. This was very well done generally as expected. Part (b)(i) was also well done. In part (b) (ii), many candidates made a sign error in their suvat equation taking the initial velocity to be positive when they were using downwards positive, or taking the initial velocity to be negative when using upwards positive. Some candidates made the more serious error of using the acceleration found in part (a) when the object was moving under gravity. There were also sign errors made with the distance 18.9.

3. This was a well done question generally though the concept of impulse needed in part (a) was not as well understood as I would have wished.

4. Extremely well done question with many candidates gaining full marks. Some candidates made the mistake of thinking that the two stages of deceleration have the same gradient, which made their calculation of the distance between *A* and *B* incorrect.

5. This was another well done question. Some candidates failed to realise that all the forces were horizontal and included the weight of the particle 4g in their y component losing 5 out of the 7 available marks.

6. Yet another well done question with many full marks solution being presented.

7. In part (a), when calculating the normal reaction, many candidates failed to take account of the contribution of the 80 N force. In part (b), some candidates failed to include either the frictional force found in (a), or the component of the weight down the slope in their N2L equation. More seriously, some candidate put the 80 N force parallel to the slope, solving a different question to the one set.

8. The simplest solution involves two equations with two unknowns. However some candidates wrote down 3 or even more equations. Some were successful in solving these. Many were not. However, almost all candidates were able to write down some correct equations.

9. This was a well done question as always. Some candidates did not like the presence of the particle *D* and ignored it altogether.

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M2

General comments

This paper proved to be one of the harder ones in recent years. However, all of the questions were assessable to most candidates. Candidates had trouble with the vector question 3, mainly because of its unstructured nature. Question 9 (b) was not as well done as usual and there were signs that candidates may be rushing and not stopping to think clearly. The lack of a clearly drawn diagram with forces marked would have eliminated a great many errors.

Comments on individual questions

1. This question was well answered by many. Some candidates tried moving the origin to x=3, usually incorrectly.

2. Generally a well answered answer. There was only one mark allocated to part (c) as candidates should be able to answer that without any working. However, candidates usually started from their derived values but some did not arrive back at the values given in the question. More seriously, much time was wasted, which may have cause their solution to question 9 to suffer.

3. This was by far the worse answered question in the paper. Some candidates tried to find when the two objects were at the same place. Others tried setting the scalar product of the two displacement vector to 0.

4. In part (a), many candidates did not realise that it is momentum that was conserved and not energy. That was by far, the commonest error.

5. Some candidates incorrectly tried to do this question using elastic energy. Hooke's law was generally well known. The mistakes come in finding expression for the natural length from the information given in the question. Disappointingly, some candidates managed to get two perfectly correct equations but did not know how to solve them. Many candidates did not solve the equations in the most direct way, but wrote a couple of pages of algebra.

6. This was a generally well done question. Some candidates had trouble with the vector constant of integration in part (b) and somehow manage to have a scalar term in a vector equation without realising that it must be incorrect.

7. Candidates were familiar with questions of this type and made good efforts toward a solution. The work done by the resistive force was sometime left out, or had a wrong sign in the work-energy equation. Some candidates simply used the force 50 N in the work-energy equation.

8. This question was surprisingly well done by many candidates. Some candidates simply pretended that it was a conical pendulum question, which of course it was not, though if they had used the angle 180º, which no one did, it might have worked.

9. Part (a) was well answered. In part (b), many candidates did not present a clear diagram and simply used the equations for a particle moving from the bottom of the circular path. This causes a sign error and resulted in the cosine of the angle when the particle leaves the surface to be greater than 1. Not many candidates who made this mistake were put out by this.

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M3

General comments

This paper did not cause many problems for most candidates. Most made decent attempts on all of the questions, though the last 3 marks in question 2(a) were not gained by many candidates. A small number of candidates did not know how to deal with the integral in question 4(c) even though the answer could be found in the formulae booklet.

Comments on individual questions

1. This question provided a good start to the paper with numerous candidates gaining full marks. The commonest error was dealing with the constant that arose in front of the ln function after integration. Some candidates omitted the constant of integration while others insisted that when t=0, v=0 even though the question clearly stated that when t=o, v=8.

2. Most candidates were able to gain the first 4 marks in part (a), but only a handful of candidates were able to correctly find the amplitude. Disappointingly, hardly anyone connected the question to a sin θ+b cos θ=R sin ($\theta+\alpha$). However, candidates manage to give good solutions to part (b).

3. As expected, the question was well answered generally. A few candidates mixed up their variables x and t causing general havoc to their solution. Others tried to find the constants in the complimentary function rather than those in the general solution.

4. Parts (a) and (b) were generally well answered. Some candidates had difficulty with the integral in part (c) coming up with a variety of incorrect answers, the commonest of which was the same integral obtained in part (b).

5. The question did not cause many problems.

6. Sin/cos errors, which had been uncommon in the past, seemed to be rather common this session. Otherwise, most candidates were familiar with questions of this type and gave good solutions. Some candidates made problems for themselves by not carefully considering the pivot when attempting a moment equation. The most serious errors occur right at the start of the question in the force diagram. The reaction at C was sometimes horizontal or vertical rather than perpendicular to the rod. Some candidates had an extra force acting at the point B.

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S1

General comments

The candidature covered the whole range with some candidates completely out of their depth at this level but also many candidates submitting excellent scripts.

Comments on individual questions

1. Parts (a) and (b) were generally well answered by most candidates. Part (c), however, proved to be difficult for some candidates who were unable to find the value of $P(A \cap B)$ in the changed circumstances.

2. This was by far the best answered question on the paper, confirming yet again that candidates are quite comfortable in solving problems involving Bayes' Theorem and the Law of Total Probability.

3. Solutions to this question were often disappointing with most candidates obtaining an equation for *a* and *b* by using the mean but some candidates unable to find a second equation using the variance. Many candidates failed to give a correct answer to (c). A common incorrect answer was along the lines of 'The mean and variance could be equal for the binomial distribution so *Y* could be binomial'.

4. This question was well answered by most candidates. The worst answered part was (b) with some candidates writing many lines of arithmetic before ending up with the wrong answer.

5. Part (a) was well answered by most candidates, the most common error being to omit the p_0 term in (a)(ii). Part (b) was correctly answered only by a minority of candidates and it appeared that a few candidates used their calculators to solve the equation $e^{-0.2t}(0.2t)^5/5! = 0.0602$. No credit was given for this approach.

6. This was the worst answered question on the paper and it was the only question for which the mean mark obtained was less than 50% of the total mark for the question. Many candidates failed to calculate correctly the probabilities in (a). In (b), many candidates were unable to convert the statement concerning the expected profit into a mathematical equation.

7. Part (a) was reasonably well answered with the candidates dealing more confidently with the unknown constants *a* and *b* than in the similar but seemingly easier work required in Q3. Part (b) caused problems for many candidates with some not considering all possible pairings. Some candidate failed to realise that 1,2 and 1,3 could occur either way round but 1,1 and 2,2 could not.

8. Parts (a) and (b) were generally well answered by many candidates although it was clear that the phrase ‘arithmetic expression’ was initially misunderstood by some candidates who thought that it had something to do with arithmetic series. In (c), some candidates used their calculator instead of tables to find the value of $P(X = 2)$, for which no credit was given. Also some candidates calculated a percentage of the calculated probability instead of the probability obtained from tables.

9. Many candidates gave reasonable solutions to (a) and (b)(i) although the presentation was often poor. Part (b)(ii) caused problems for many candidates with some believing that the median m is given by $F(0.5)$ instead of satisfying the equation $F(m) = 0.5$.

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S2

General comments

The general standard was good with a handful of excellent scripts. The interpretation of *p*-values is sometimes unsatisfactory with candidates failing to give a conclusion in context when required.

Comments on individual questions

1. Part (a) was well answered by most candidates. However many candidates were unable to answer (b) correctly. The most common error was to assume that *XY* followed a Poisson distribution with mean 6 so that the incorrect answer 0.1339 was often seen.

2. This was the best answered question on the paper. The most common errors, rarely seen, were using an incorrect *z*-value and rounding the answer to (b), namely 55.47..., down to 55 instead of up to 56.

3. Parts (a) and (b)(i) were well answered in general. In (b)(ii), however, many candidates calculated the variance incorrectly.

4. This was by far the worst answered question on the paper. Although many candidates found the correct critical region, most of these were then unable to find what is effectively the probability of a Type II error in (b)(i). Many candidates just ignored the modulus signs so that $|\overline{X} - \overline{Y} \leq 1.473|$ became $\overline{X} - \overline{Y} \leq 1.473$. Many other candidates did not know how to proceed.

5. In (a) (ii), some candidates found difficulty in using the tables to find a binomial probability with a value of *p* greater than 0.5. Some candidates failed to give their conclusions in context in both (a)(ii) and (b).

6. Most parts of this question were well answered although some candidates were unable to proceed beyond showing that $P[X^2 - 20X + 64 < 0]$. In (c), even after solving (b)(i) correctly, some candidates assumed incorrectly that *X* and *Y* were independent so that $E(XY) = E(X)E(Y) = 75$.

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S3

General comments

The standard of the scripts was generally good with some excellent scripts. As in previous years, the question on estimation theory was the worst answered question on the paper.

Comments on individual questions

1. Solutions to this question were often disappointing with some candidates omitting one of the possible samples and/or calculating the probabilities incorrectly. Some candidates misread the read and calculated the expected value of the mean.

2. Most candidates calculated unbiased estimates for the mean and variance correctly. Most candidates then went on to calculate a correct test statistic. Some candidates then treated this as a *z*-statistic instead of a *t*-statistic so that the following work was incorrect. Some of the candidates who considered their statistic as a *t*-statistic used the 2-tail 5% critical value, namely 2.262, instead of 1.833.

3. This was the best answered question on the paper. The most common error seen was an incorrect transition from the tabular value found in (b) (ii) to the confidence level.

4. Part (b) was well answered in general although some candidates calculated the standard error incorrectly. Solutions to (c) were often extremely poor. It is disturbing that the Central Limit Theorem is not understood by the majority of the candidature. A common mistake is to believe that if the sample is large, then the sampled distribution and not the sample mean tends to normality. It is worrying that the majority of candidates leave their statistics course without understanding what is arguably the most important result in statistics.

5. Candidates are generally confident in solving questions on this topic and most candidates found a and b correctly, almost invariably by first calculating S_{xx} and S_{xy}. Some candidates misread the question, thinking that they were required to calculate the minimum width confidence interval and not just give the value of *x*, namely 35, for which the width is minimum.

6. This was by far the worst answered question on the paper. Some candidates answered (a)(i) by simply writing that $E(\overline{X}) = E(X) = \mu$ apparently not realising that they had assumed the result that had to be proved. Similarly, in (a)(ii), some candidates just wrote $\mathrm{Var}(\overline{X}) = \dfrac{\sigma^2}{n}$ $\mathrm{therefore}$ $\mathrm{SE}(\overline{X}) = \dfrac{\sigma}{\sqrt{n}}$. Solutions to (b)(ii) were extremely disappointing in general with many candidates considering S^2 instead of $E(S^2)$. Solutions to (c) were few and far between.

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