GCE EXAMINERS' REPORTS

MATHEMATICS M1-M3 & S1-S3
AS/Advanced

SUMMER 2015

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MATHEMATICS

General Certificate of Education

Summer 2015

Advanced Subsidiary/Advanced

M1

Principal Examiner: Dr S Barham

General comments

This was a good paper enabling most candidates to show off their knowledge of mechanics. Candidates were able to attempt all of the questions and there was no evidence that they found the paper too long. The most challenging questions were 5(b) and 6(d).

Comments on individual questions

Q1.   This question provided a good start to the paper for many candidates though it was not as well received as I had hoped. The problems arose with candidates not being able to isolate the forces acting either on the man or the man and the lift as a single entity, as they only drew a single diagram. Often, extra forces were included in the N2L equation. Many candidates made mistakes with the direction of the acceleration resulting in sign errors when the value of the acceleration was substituted into the equation.

Q2.   This question was reasonably well done with the usual mistakes being much in evidence. These being: forgetting the component of weight down the slope, sin/cos errors in resolving forces or just treating the particles as if they were both hanging freely.

Q3.   This question was well done as usual. Candidates who use the ratio method to find e, the coefficient of restitution, being slightly less successful as sign errors were rather more common.

Q4.   Candidates fell into two separate categories here. Either they got all the marks efficiently, or they had no idea how to proceed.

Q5.   Part (a) was reasonably well done. Candidates were rather less successful with part (b). They often use the same symbol, usually *x*, to mean two different distances, causing chaos and some difficulty in marking. Presentation of their solution left much to be desired especially as often, only an equation was seen with no indication of the pivot, sometimes even without a diagram. This was fine if the equation was correct, but caused much difficulty when the distances were not the correct ones.

Q6   Parts (a), (b) and (c) of this question were standard and very well done as usual. Not many candidates had a correct solution for part (d). Often, they equated the velocities of the car and the bus, instead of the distances travelled by the car and the bus.

Q7.   The first 4 marks were often gained but many candidates had difficulty in solving the resulting two linear simultaneous equations because the coefficients were not integers.

Q8.   Both parts of this question were well done generally. Many candidates had the incorrect answer 3 instead of the correct answer 4 in part (b). I suspect they correctly worked out that 3 more bounces were required but failed to answer the question posed in the paper.

Q9.   This was a well done question as always. The commonest error was the miscalculation of the area of the circle. A variety of π based expressions were seen. The majority of candidates did not spot the axis of symmetry at $y=5$. Some calculated it correctly but sadly many did not.

MATHEMATICS

General Certificate of Education

Summer 2015

Advanced Subsidiary/Advanced

M2

Principal Examiner: Dr S Barham

General comments

This paper was of a good standard compared to others of its kind. There was no evidence of it being too long as most candidates had time to try all of the questions on the paper. All of the questions proved to be assessable. Candidates found questions 2(a), 3, 4(b) and 7 rather more challenging than the rest of the paper.

Comments on individual questions

Q1.   Most candidates knew the scalar product was required here. A small number thought the scalar product was a vector, keeping the **i** and **j**'s throughout. One or two thought the scalar product needed to be -1 for the vectors to be perpendicular. It was disappointing to see so many candidates leaving their C1-4 knowledge at home when doing a mechanics paper. They were unable to recall the double angle formula required here. Some managed to derive it correctly, while others came up with some very strange alternatives.

Q2.   In part (a), many candidates were not able to translate "the resistance proportional to time" into correct mathematics. Some candidates did not use N2L but decided to work backwards, usually unsuccessfully. However, most candidates were able to recover and gain almost all the marks in part (b).

Q3.   Although both of the equations required were the result of N2L, many candidates only manage to obtain one equation correctly. Some candidates had dimensionally incorrect equation using power in their N2L equation, resulting in the loss of almost all the marks available. Candidates who managed to obtain both equations were generally able to correctly solve them for the final answers. However, some were not able to cope with the fractional coefficients, which was disappointing.

Q4.   Part (a) of this question was generally well done with some candidates saying they are dividing by 0.5 but actually multiplying by 0.5 instead. Some candidates integrated **F** to obtain **v**, losing all of the available marks. Part (b) was badly done with many candidates going down the wrong path of $I = F.t$. Not many correct solutions were seen.

Q5.   This was a very well received question though many candidates lost the last two marks by missing out a bit of elastic energy, or not dealing completely correctly with the potential energy. Some candidates lost the difference in potential energy completely.

Q6   Questions of the type are usually well done and this one is no exception. A few candidates concerned themselves with the height of the tree, which was irrelevant, and in any case, there was not enough information in the question for it to be calculated.

Q7.   This was a poorly done question as is usual with questions on this topic. Candidates forget to resolve the acceleration towards the centre of motion, especially those who try to consider motion perpendicular to the plane or along the plane.

Q8.   Part (a) of this question had been set numerous times previously in various guises and was well done by many candidates. In part (b), some candidates went into auto-pilot and considered motion at the top of the circular path, which was irrelevant here. The difference between $v^2=0$ or $T=0$ did not seemed to be well understood by candidates.

MATHEMATICS

General Certificate of Education

Summer 2015

Advanced Subsidiary/Advanced

M3

Principal Examiner: Dr S Barham

General comments

Candidates did not find many surprises on this paper. There were very many excellent scripts. All the questions proved to be assessable. Almost all candidates managed to attempt all the questions on the paper; there was no evidence that this paper was anything other than the correct length. The question on SHM (question 4) was harder than usual and even the competent candidates did not obtain all 5 marks available for part (b)(i).

Comments on individual questions

Q1.   This question provided a good start to the paper. A few candidates thought mistakenly that the acceleration could be written as dv/dx. Some candidates did not realise that they had to use the initial equation to find the acceleration for (b)(ii) and lost the last 2 marks. Many candidates left out this bit of the question completely.

Q2.   This was a very well done question by almost everyone. In part (a), some candidates went into auto pilot and found a particular integral, which of course turned out to be zero. In part (b), some repeated the work they had already done in part (a) which was not required.

Q3.   This was also a well done question with a sign error in the ln integration being the commonest error. A small number did not know how to proceed in part (c) as they did not realise that the expression for v found in part (b) could be integrated with respect to t to find x. Others integrated incorrectly dividing by 5 instead of 1/5.

Q4.   Questions on SHM are usually very well done with many candidates gaining full marks. However, this question proved to be an exception. Many candidates found parts (a) and (b)(i) beyond their capabilities. Many candidates actually assumed SHM. Most solutions were presented without a clearly labelled diagram and it was sometimes difficult to determine how the candidate arrived at their equations. This was fine when the solution was perfect which often was not true. Some went down the wrong path of considering energy instead of the correct path of considering equilibrium of the forces involved. However, most candidates were able to recover for the last 7 marks of the question.

Q5.   Not very many candidates knew to use the sine rule to find the required angle in part (a). The triangle was obviously scalene but disappointingly, many candidates treated it as if it was a right angle triangle. Part (b) was either very well done or candidates seemed to have no idea how to proceed.

Q6.   It was a pleasant surprise to find that this was one of the best answered questions on the paper.

MATHEMATICS

General Certificate of Education

Summer 2015

Advanced Subsidiary/Advanced

S1

Principal Examiner: Dr J Reynolds

General Comments

The candidature was extremely variable with some candidates out of their depth at this level but also many candidates submitting excellent scripts.   The worst answered question was the one on continuous distributions.   The best answered question was the one involving Bayes' Theorem where the use of a tree diagram was helpful for many candidates.

Comments on Individual Questions

Q1.   Part (a) was well answered in general with most candidates realising that the first step was to calculate the mean and variance of *X*.   In Part (b), however, some candidates assumed incorrectly that *Y* was binomially distributed, failing to realise that $Y = 7$ was equivalent to $X = 3$.

Q2.   Some candidates used a verification method in (a) by simply substituting 0.3 into the appropriate equation and showing that this value satisfied the equation.   This method was only awarded part marks on the grounds that although it showed that 0.3 was a root, it did not show that it was the only root.   Part (b) was well answered in general but (c) caused problems for some candidates who failed to realise that the correct expression to use was

$$P(B \mid A') = \frac{P(B) - P(B \cap A)}{1 - P(A)}$$

Q3.   Questions on selecting samples without replacement are usually the best answered questions on these papers.   This time, however, this was not the case.   Most candidates solved (a) correctly but (b) caused problems for many.   A fairly common solution was 2/9, which assumes that Ann definitely chooses a green sweet initially. The expectation was that candidates would use the Law of Total Probability and many did that, not always correctly.   Some candidates simply wrote down the correct answer 2/10, either realising, perhaps subconsciously, that Ann's choice was irrelevant or perhaps because they had seen similar problems in class.

Q4.   Solutions to (a) were generally good but (b) proved to be difficult for many candidates.   The incorrect solutions 18 and 20 were seen occasionally with some candidates making no attempt at this part of the question.

Q5. Questions involving Bayes' Theorem are generally well answered and this was no exception, being the best answered question on the paper.

Q6. Solutions to both (a) and (b) were generally good. The most common error was an incorrect interpretation of the phrase 'between 3 and 8 (both inclusive)'.

Q7. In (a), some solutions were less than convincing, for example

$$k\left(\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\frac{1}{6}\right)=1 \text{ therefore } k=\frac{4}{5}$$

was only given partial credit since the value of k was given in the question. An intermediate step such as

$$k \times \frac{15}{12}=1$$

was required to be seen. Solutions to (b) were often disappointing with candidates realising that they had to evaluate $\sum xp_x$ but making errors in carrying this out.

Q8. Part (a) was well answered in general and many candidates obtained correct answers to (b)(i) and (ii). In (b)(iii), however, some candidates gave the answer as 0.24 + 0.1344, not realising that the game could progress beyond that stage. Even candidates who realised that the required probability was an infinite geometric series often used an incorrect first term and common ratio.

Q9. As usual, the question on continuous distributions was the worst answered question on the paper, although (a) was reasonably well answered by many candidates. In (b), however, although most candidates realised that integration is required to find $F(x)$ starting from $f(x)$, many candidates simply used either no limits or the incorrect limits $0,x$. Some candidates used the incorrect notation

$$F(x)=\int_1^x f(x)\mathrm{d}x$$

in which the same letter is used to denote both the dummy variable and the upper limit but this was condoned even though it is technically incorrect. In (b)(iii), some of the candidates who obtained the correct equation for the median m, ie $m^4-8m^2+11.5=0$, failed to recognise this as a quadratic equation in m^2.

MATHEMATICS

General Certificate of Education

Summer 2015

Advanced Subsidiary/Advanced

S2

Principal Examiner: Dr J Reynolds

General Comments

The general standard was good with a handful of excellent scripts. As reported in previous years, continuity corrections are 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. Also, some candidates fail to give a conclusion in context when this is asked for.

Comments on Individual Questions

Q1.   This was well answered by most candidates. In (b), however, some candidates failed to give the conclusion in context.

Q2.   Part (a) was well answered by many candidates although some gave the 5th percentile instead of the 95th. Solutions to (b) were sometimes disappointing with candidates finding the two correct values of *z* but then dealing incorrectly with the two probabilities obtained from the tables. It was encouraging to note that (c), involving a linear combination of normal random variables, was well answered in general although some candidates calculated the variance incorrectly

Q3.   Part (a) was well answered by many candidates although some candidates used an incorrect standard error in their calculation of the test statistic.

Q4.   Solutions to (a) were often disappointing with answers of 13 or 15 given instead of the correct 14. In (b), the continuity correction was either incorrect or not present and the conclusion was sometimes not given in context.

Q5.   Candidates who found the correct mean and variance of the score on a dice almost invariably went on to apply the Central Limit Theorem correctly. Some candidates used the binomial theorem incorrectly to find these values and some candidates failed to realise that the first step was to find the mean and variance.

Q6.   This question was generally well answered. As usual, the most common errors were the use of an incorrect or no continuity correction and failure to give a conclusion in context.

Q7.   Many candidates gave incorrect solutions to (a)(i), a common error being to assume that Y was uniformly distributed on the interval $[\sqrt{a}, \sqrt{b}]$. In (a)(ii), most candidates failed to give the complete specification for the probability density function with the statement that $f(x) = 0$ outside the interval $[\sqrt{a}, \sqrt{b}]$ being omitted.

MATHEMATICS

General Certificate of Education

Summer 2015

Advanced Subsidiary/Advanced

S3

Principal Examiner: Dr J Reynolds

General Comments

The standard of the scripts was generally good with some excellent scripts.

Comments on Individual Questions

Q1.   This question was well answered by many candidates. The most common errors, not often seen, were the omission of one or more possible combinations and incorrect probability calculations.

Q2   Most candidates calculated unbiased estimates for the mean and variance correctly and then went on to use the *t*-distribution to find the confidence interval.
Some candidates used a *z* value instead of a *t* value. Candidates should be aware that if the variance has to be estimated, then the *t*-distribution should be used.

Q3.   This question was well answered by most candidates. The most common errors were calculating an incorrect standard error and failure to give the conclusion in context.

Q4.   Part (a) was well answered in general. In (b), however, some candidates used the value of $\hat{p}$ found in (a), not realising that the new confidence interval would correspond to a different value of $\hat{p}$.

Q5   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}.
In (b) and (c), some candidates chose incorrect expressions for the standard errors from the Information Booklet.

Q6.   This was the worst answered question on the paper. In (a), many candidates showed that
$$a(4-10\theta)+b = \theta$$
but some failed to realise that the values of *a* and *b* could be found by treating this as an identity. In (b), some candidates failed to realise that the number of 4s was binomially distributed with parameters $(n, 1 - 6\theta)$ and were therefore unable to determine the properties of *V*. In (c), most candidates were able to state that *V* was the better estimator since the relevant information was given in the question.