MATHEMATICS

General Certificate of Education (New)

Summer 2019

Advanced Subsidiary/Advanced

APPLIED MATHEMATICS B – A2 UNIT 4 SECTION A

General Comments

This paper proved rather challenging for many candidates. As one would expect, there were also some well answered scripts. It was evident that candidates were not accustomed to thinking critically about their work. The new specification requires more thought to be given to questions and their corresponding answers rather than following processes as a matter of routine. Questions that required explanation were, once again, the least well answered.

Comments on individual questions/sections

Q.1 This question was the most well answered question of the statistics section of the paper. Candidates were adept at using their answers from part (*a*) in part (*b*). There were a small proportion of candidates who had trouble with the ratio aspect of the question, with some assuming each probability was to be multiplied by $\frac{1}{3}$ rather than the appropriate proportions from the question. Some were able to miscount the number of parts of the ratio, but still end up with the correct answer in part (*b*).

Q.2 This question was slightly less well answered than question 1, but still proved to be accessible to most candidates. All but the weakest candidates correctly answered part (*a*)(i). Most candidates were able to give good attempts at parts (ii) and (iii), but lost track of how many turns each player had taken, which led to parts of the solution being correct, but falling short of a fully correct solution. Many candidates seemed unwilling or unable to use fractions and ended up losing accuracy, especially when rounding each individual part of the answer to two decimal places. Candidates are reminded that they should round their final answer to an appropriate degree of accuracy, rather than at any intermediate stage.

Q.3 Most candidates were able to gain some marks in this question. It was somewhat surprising to see that, although candidates could give one assumption, they were not often able to give both the assumption of independence of events and a constant probability of success for a binomial distribution in the context of the question. Candidates were often able to give one way that the distribution changed in part (*b*), but not two ways. It should be noted that the distribution does not become a normal distribution, but rather, it can be approximated by a normal distribution.

Q.4 Most candidates were able to answer part (*a*) correctly by using the calculator. Candidates who went down this route, but did not arrive at the correct answer, forfeited the method mark. Part (*b*) was the most challenging part of this question, with a considerably larger proportion of candidates than expected unable to use the correct limits. The realisation that the distribution of $\bar{X}$ was required to answer this part was not common. A variety of methods were used in part (*c*), with some common errors being incorrect hypotheses, for example, $H_0 = 16 \cdot 02$ and $H_1 \neq 16 \cdot 02$, comparing *p*-values to critical values, and not accounting for the two-tailed nature of the test.

Q.5 Part (*a*) provided a good opportunity for candidates to gain marks with many candidates able to produce fully correct solutions. Some candidates miscounted the number of points and some candidates were unsure how to work out the correct value for n. In part (*b*), candidates were often able to state that there was correlation between fish consumption and bowling alley revenue, but did not reference the *p*-value. By far the most common error was to not consider the irrelevance of the findings in parts (*a*) and (*b*).

Summary of key points

- Candidates should always consider the reasonableness of their answers. This includes recognising that probabilities should be between 0 and 1, and assessing the suitability of conclusions resulting from hypothesis testing.

- It was encouraging to see candidates engaging well with probability questions. However, candidates are encouraged to develop the mathematical skills and understanding associated with conditional probability.

- Candidates are encouraged to recognise when the distribution of the sample mean should be used to answer questions.

- It would be of benefit to candidates to learn the assumptions of a binomial distribution and a Poisson distribution and be able to apply them in context.

MATHEMATICS

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APPLIED MATHEMATICS B – A2 UNIT 4 SECTION B

General Comments

The paper allowed candidates of all abilities to display their knowledge and demonstrate their mathematical skills. Many exemplar responses were seen for all of the questions in Section B.

The attempt rate for some questions suggests that time may have been an issue for some candidates, or some may have invested too much time on questions earlier in the paper.

Notably, question 8 and question 10 were the most demanding of the mechanics questions, whilst question 7 was by far the most successful.

Comments on individual questions/sections

Q.6 Part (*a*) was generally well answered, with almost all candidates making the correct decision to differentiate $\mathbf{v}$ and then use Newton's second law.

Responses were less successful for part (*b*), with a variety of different errors occurring. Many struggled to find the constant of integration in a vector setting with some simply stating that $\mathbf{c} = 4\mathbf{i} + 7\mathbf{j}$. More seriously, some candidates used $\mathbf{v}$ and their expression for $\mathbf{a}$ from part (*a*), along with $\mathbf{s} = \mathbf{u}t + \frac{1}{2}\mathbf{a}t^2$ to get expressions similar to

$$\mathbf{s} = \left(12\cos(3t)\mathbf{i} - 5\sin(2t)\mathbf{j}\right)t + \frac{1}{2}\left(-36\sin(3t)\mathbf{i} - 10\cos(2t)\mathbf{j}\right)t^2 .$$

As expected, sign errors were common throughout the entire question.

In part (*c*), almost all candidates made the decision to substitute $t = \frac{\pi}{2}$ into their expression for $\mathbf{s}$, but many gave their final answer as $\mathbf{r} = 2\mathbf{j}$, thus forfeiting the final mark awarded for the distance *OP*.

Q.7 This was the most successful question on the paper. Notably, the scores for this question had a small standard deviation, thus suggesting that responses were consistent.

In part (*a*), most candidates used the trigonometric ratios to deduce that $\sin\alpha = \frac{3}{5}$ and $\cos\alpha = \frac{4}{5}$. However, some candidates evaluated $\alpha = 36.9^\circ$ to one decimal place. Whilst this approach can often be inefficient, fortunately, in this instance, it did not result in any loss of accuracy marks.

Part (*b*) saw some longer responses than were necessary for 1 mark, yet candidates demonstrated very good knowledge of the principle being examined.

Q.8 Given that this was a basic differential equation, it was disappointing to see that efforts were generally poor in this question. Part (*a*) was well received. However, in part (*b*), many struggled to legitimately separate the variables. Furthermore, for those candidates who were successful in separating the variables, many made sign errors when integrating v^{-2}.

Unfortunately, a large proportion of candidates did not attempt part (*c*), mainly because they failed to get a final result in part (*b*).

Q.9 It was reassuring to see that candidates were not overly troubled by the context of this question. The majority of errors were attributed to either sign errors or poor mathematical notation.

In part (*a*), many dealt with moments about a point, but initially excluded the T_i term. For example, for taking moments about wire 2, the following was seen:

- $mgd_C = mg(1+d_A) + mg(1-d_B) \Rightarrow T_1 = mg(1+d_A) + mg(1-d_B) - mgd_C$
- $mg(1+d_A) + mg(1-d_B) - mgd_C = 0 \Rightarrow T_1 = mg(1+d_A) + mg(1-d_B) - mgd_C$

Many sign errors stemmed from incorrectly identifying the direction of certain moments and also from rearranging equations, with many having to 'tinker' with their solution to try to convince examiners of the printed result for T_1.

Remarkably, a significant number of candidates did not opt for the 'standard' solution. Instead, two applications of moments were considered: one about wire 1, another about wire 2. For those who made mistakes in setting up a 'moments' equation, this approach was much less successful than resolving forces vertically.

Q.10 Unfortunately, this was the least accessible question on the whole paper. The specification now covers the formulae for constant acceleration for motion in a straight line for 2 dimensions using vectors. Thus, for this question on the projectile of a tennis ball, two possible approaches were possible. Very few candidates opted for the vector method using $\mathbf{a} = -g\mathbf{j}$. The vast majority elected to work with the horizontal and vertical components separately in keeping with the approach for the legacy specification. Therefore, the performance of this particular question was disappointing. Overall, candidates were comfortable in selecting and applying the appropriate formulae, but most of the errors were due to candidates not selecting a clear sign convention and not realising that the point of projection was not the origin.

Part (*a*) was generally well answered. Part (*b*) was less successful and $\mathbf{s} = 12\mathbf{i} - 1 \cdot 344\mathbf{j}$ was often seen, instead of $\mathbf{s} = 12\mathbf{i} - 1 \cdot 344\mathbf{j} + 2 \cdot 4\mathbf{j}$.

It was disappointing to see some candidates forgetting the acceleration altogether by simply integrating the velocity vector, i.e.

$$\mathbf{s} = \int (30\mathbf{i} - 1 \cdot 4\mathbf{j})\mathrm{d}t \,,$$

leading to $\mathbf{s} = 30t\mathbf{i} - 1 \cdot 4t\mathbf{j} + \mathbf{c} \quad \Rightarrow \quad \mathbf{s} = 30t\mathbf{i} - (2 \cdot 4 - 1 \cdot 4t)\mathbf{j} + \mathbf{c}$.

Sadly, possibly due to time issues, a very large proportion of candidates did not attempt part (*c*). However, almost all of those who attempted it were able to successfully answer both parts of the question. This demonstrated familiarity with Assessment Objective 3 (AO3) which assesses the ability to recognise the limitations of models and to explain how to refine them.

Summary of key points

- Marks continue to be lost due to incorrectly separating the variables in a differential equation.
- Candidates need to be reminded that the equations of motion can only be used for constant acceleration $\mathbf{a}$.
- The most successful candidates used the trigonometric ratios associated with $\tan\alpha = \frac{3}{4}$, rather than evaluating α.
- Some candidates did not consider the sensibility of their responses by referring back to the original model. For example, some suggested playing a game of tennis in a vacuum.