MATHEMATICS

General Certificate of Education (New)

Summer 2019

Advanced Subsidiary/Advanced

APPLIED MATHEMATICS A – AS UNIT 2 SECTION A

General Comments

The variety of topics that the subject content for this unit offers meant that some questions on the paper seemed familiar to candidates and were generally well answered, whereas other questions seemed less familiar and were not as well answered. Once again, this year, questions involving insight, notably questions 2(*d*) and 4(*c*), were answered correctly by only a small proportion of candidates.

Comments on individual questions/sections

Q.1 This question was a familiar opening question which many candidates answered very well. A common error was to assume that the events *A* and *B* were independent which meant that $P(A \cap B) = 0$. This error lead to $P(A) = 0 \cdot 55$ and then subsequently to $P(A \cap C) = -\frac{7}{60}$. Many candidates were either unable to find and rectify their error, or were simply unaware that this was an invalid probability.

Q.2 This was, by far, the most poorly answered question on the paper. In part (*b*), all but the weakest candidates identified the binomial distribution $B(50, 0.3)$. From there onwards, the errors started to creep in. Some candidates thought an appropriate hypothesis test would involve evaluating $P(X = 21)$. This scored no further marks.

In part (*d*), the vast majority of candidates did not appreciate that, when conducting a hypothesis test, the hypotheses should be formed before looking at the data. This led to a plethora of incorrect answers, including "Ali should not need to worry about a hypothesis test because the percentage has now improved to 35%," which showed a complete lack of understanding about the whole process of hypothesis testing.

Q.3 Many candidates were comfortable answering part (*a*). When using the calculator to calculate cumulative probabilities for the binomial distribution, candidates should be aware that the calculator gives $P(X \leq x)$. One of the most common errors in this part of the question was to identify the first value for X that gave an answer less than 0.09 and then to conclude that $n = 3$, or even $n = 4$. This question required finding $P(X \geq x) < 0 \cdot 09$ which involved subtracting the value given by the calculator from 1. Part (*c*) was surprisingly well answered.

Q.4 Part (*a*) proved to be very accessible, with many candidates offering thoughtful answers to (ii). Although candidates are required to calculate the mean from a grouped frequency table at GCSE level, this was not evident here. Calculating the standard deviation would have been less familiar to candidates and this was equally poorly attempted. Surprisingly, some candidates managed to calculate the standard deviation, but were unable to identify the mean. In part (*c*)(ii), despite many candidates making the error of agreeing with Angharad, most candidates could identify that the area was the important characteristic of a histogram, but were unable to comment on the uncertainty of Angharad's statement in enough detail.

Q.5 Despite seeing many good responses to individual parts of this question, very few candidates were able to answer the whole question correctly. Common errors included calling Huw's sampling "stratified sampling", telling Huw to ask every 10^{th} person he saw on the street (which was clearly impractical), and using 889 000 in the regression line.

Summary of key points

- Candidates are encouraged to consider whether their answers are reasonable. Candidates should not be content with answers that include negative probabilities, or probabilities greater than 1.

- Candidates should familiarise themselves with hypothesis testing developed through a binomial model.

- It was disappointing that candidates were not able to recall some of the subject content from the GCSE course.

- Calculators are a useful tool to aid the calculation of probabilities from the binomial and Poisson distributions. Candidates are encouraged to be more adept at using the calculators effectively.

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APPLIED MATHEMATICS A – AS UNIT 2 SECTION B

General Comments

The paper allowed candidates of all abilities to display their knowledge and demonstrate their mathematical skills. It was apparent that there was sufficient time to answer Section B of the paper. All questions appeared to be generally accessible to most candidates, with the exception of questions 7(*c*) and 9(*b*) which only a minority were able to tackle successfully.

Many exemplar solutions were seen for all of the questions in Section B.

Comments on individual questions/sections

Q.6 Part (*a*) was answered extremely well, with almost all candidates making the correct initial decision to find the resultant of the three forces. However, it was concerning to see that some simplified $\mathbf{F} = (11+a)\mathbf{i} + (b-5)\mathbf{j}$ to $\mathbf{F} = 11a\mathbf{i} - 5b\mathbf{j}$.

A small number of candidates did not consider the resultant, but instead applied Newton's second law to each individual force separately, i.e. $\mathbf{F}_2 = 2(7\mathbf{i} - 3\mathbf{j})$.

Many were comfortable with the requirements of part (*b*), yet were unable to communicate their solution mathematically, e.g.

$$14\mathbf{i} - 6\mathbf{j} = 0 \qquad \therefore \qquad \mathbf{F}_4 = -14\mathbf{i} + 6\mathbf{j}$$

Q.7 Parts (*a*) and (*b*) of this question were generally well done considering that this was the first time that a displacement-time graph has featured in the assessments for the reformed specification. Disappointingly, a small number of candidates were unable to deduce the total distance travelled.

Only a small number of candidates were able to successfully answer part (*c*)(i) with an even smaller proportion answering (*c*)(ii) correctly. In some responses, it was clear that the graph was mistaken for a velocity-time graph. The question was designed to examine candidates' understanding of concavity and the fact that speed and velocity will only differ when the velocity is negative. Hence, the solution to (*c*)(ii) was a subset of (*c*)(i).

Q.8 Overall, candidates were comfortable in selecting and applying the appropriate formulae for vertical motion under gravity. The majority of errors were due to not selecting a clear sign convention.

Remarkably, a significant number of candidates did not opt for the most efficient solution to part (*b*). Instead, the upward and downward motions were considered separately. Since this involved two applications of the constant acceleration formulae, this approach was less successful.

Correct answers to part (*c*) were generally accompanied by a correct response to part (*d*).

Q.9 This was the least accessible mechanics question on the paper. However, part (*a*) was very successful, with almost all candidates recognising that integration was required to obtain an expression for the velocity. Also, in comparison to Summer 2018, candidates were much more adept at finding the unknown constant using the initial conditions.

Responses to part (*b*) were generally disappointing. The success of part (*a*), together with the low standard deviation for the question overall, support this fact. Many did not take advantage of the fact that acceleration was constant for $t > 5$. Consequently, many replicated the 'calculus' method used in part (*a*) with the same, albeit incorrect in this instance, initial conditions, to get

$$v = \int 2\mathrm{d}t = 2t + 12 .$$

Therefore, the incorrect answer of $v = 2(14) + 12 = 40$ was frequently seen.

Q.10 This was by no means a straightforward question as it was designed to assess problem solving (AO3), incorporating algebra with the additional challenge of two possible scenarios. Nevertheless, this did not impact on the accessibility of the question as it was the most successful on the entire paper.

In general, candidates comfortably used Newton's second law to isolate each particle to set up two equations. The unknown mass of particle *B* rarely posed a problem.

Two approaches were used, roughly in equal measure. One method was to find T immediately, following the application of Newton's second law to particle *A*. The alternative method was to apply Newton's second law to both particles, then solve the resulting equations simultaneously by eliminating T to find M. The first method was the most successful, possibly as less algebraic manipulation was required.

Many candidates only considered one possible case for the acceleration of the system.

Part (*b*) was generally well answered, with most recognising that the tension would be influenced, as opposed to the acceleration.

Summary of key points

- Many candidates made preventable sign errors as they did not decide on a sign convention before attempting their solution. A clear comment at the outset such as '*take down as positive'* would be helpful.
- Many candidates continue to use incorrect mathematical notation.
- Some candidates struggled to provide alternative modelling assumptions, since air resistance had already been mentioned in the question.
- Knowledge and understanding of concavity were disappointing.