FURTHER MATHEMATICS

General Certificate of Education (New)

Summer 2019

Advanced Subsidiary/Advanced

FURTHER MECHANICS B – A2 UNIT 6

General Comments

This is the first assessment of this unit in the reformed specification and so it was reassuring to see that it was well received by most candidates. It also differentiated between candidates of all abilities. Many high scoring scripts were seen and this unit was a pleasure to mark. There was no evidence to suggest that candidates found the paper too long to complete in the allocated time, as most candidates managed to attempt all the questions on the paper.

Interestingly, the three least accessible questions on the paper, questions 2, 4 and 5, covered content new to the specification.

Comments on individual questions/sections

Q.1 This was by far the most successful question on the paper with only occasional sign errors occurring. Some of these sign errors were due to candidates electing to use the substitution $u = 9000 - v^2$ instead of $\int \frac{f'(v)}{f(v)} \mathrm{d}v$.

Part (*d*) often prevented candidates from obtaining full marks as many did not deduce that $v = 30\sqrt{10}$ was a limiting value.

Q.2 Candidates were aware of the required approach for this type of question, with almost all arriving at a centre of mass for part (*a*). Unfortunately, a small number of candidates failed to include the particle at Y in their calculations.

For the area of the lamina, a variety of methods were seen. Some candidates made the decision to sum two rectangles and a triangle. This approach turned out to be much less rewarding than the more efficient method of subtracting a triangle from a rectangle.

The majority of errors were made in the calculation of at least one of the coordinates for the centre of mass of the semi-circle. The value $5 + \frac{32}{\pi}$ was frequently seen since candidates worked relative to the point X instead of the vertex Y.

The most successful candidates constructed one table for both $\bar{x}$ and $\bar{y}$.

It was gratifying to see that almost all candidates correctly identified the correct triangle required in part (*b*), irrespective of any misconceptions in part (*a*).

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Q.3 Despite the purely algebraic setting, this question was very successful overall.

For part (*b*)(i) a small number of candidates incorrectly wrote

$$T = \frac{14(e+x)}{l} - mg\,.$$

Fortunately, many of these went on to correctly answer part (ii). In part (iii), many candidates were able to state the maximum extension as e, but, disappointingly, some of these were unable support it with a convincing reason.

Part (*c*) did not pose any problems, often allowing those who struggled with the earlier parts to secure six marks.

Q.4 Almost all candidates answered part (*a*) correctly. Some candidates dealt with the $\mathbf{i}$ and $\mathbf{j}$ components in separate equations.

Part (*b*) was less successful. Restitution was often erroneously applied to the whole vector as shown below,

$$\mathbf{v} = -\frac{5}{7} \times (-3\mathbf{i} + 7\mathbf{j}) = \frac{15}{7}\mathbf{i} - 5\mathbf{j}\,.$$

Consequently, some candidates had to deal with a much more demanding impulse equation in part (*c*).

Most of the correct responses in part (*d*) used $\text{time} = \dfrac{\text{distance}}{\text{speed}}$ to get $t = 0\cdot35$.
However, a significant proportion using this method then failed to add $1\cdot75$ to their final answer.

It was encouraging to see that the vast majority of candidates were able to successfully answer part (*e*). 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.

Q.5 This was by far the least accessible question on the paper. In part (*a*), many candidates needlessly derived the equation for the volume of a hemisphere, thus wasting valuable examination time. This was disappointing since there is a similar question in the GCE Further Mathematics Sample Assessment Materials, in the A2 Unit 6 paper. Furthermore, some responses were ambiguous as it was not clear if the π's had been cancelled, e.g.

$$\overline{x} = \frac{\int_0^r xy^2 \mathrm{d}x}{\frac{2}{3}r^3}\,.$$

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In part (*b*), the least effective solutions did not involve constructing a table including the mass of the solids, together with the corresponding centre-of-mass distances from a fixed point. In a small number of responses, the hemisphere and cylinder were treated as though they had equal density. Also, for the distance of the centre of mass of the hemisphere from the plane face base of the composite solid, some candidates simply wrote $\frac{3r}{8}$ and forgot to add $2r$.

Q.6 Candidates demonstrated a very strong understanding of how to resolve forces. As a result, this was the second most successful question on the paper. The fact that this question was set purely algebraically rarely posed a problem.

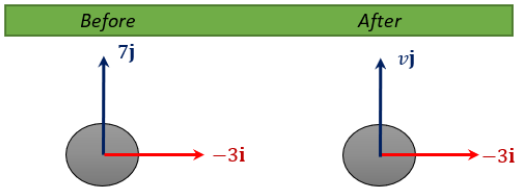
In part (*a*), a small number of candidates chose to take moments about the point A. As expected, due to the additional terms, this method was slightly less successful.

In general, the frictional force from part (*a*) was effectively used in part (*b*), with the correct value of $x = 5$, with the main error being attributed to using $\tan\theta = \frac{1}{4}$ instead of $\tan\theta = 4$.

Summary of key points

- Many candidates did not know that the law of restitution need only be applied along the line of impulses. Furthermore, if restitution calculations are needed, the line joining the centres of the spheres will always be parallel to either $\mathbf{i}$ or $\mathbf{j}$.

- The most successful candidates drew clear diagrams and constructed tables, where appropriate, to help them interpret the information in the questions, e.g. in question 4,



- Many candidates did not identify that $\ln\left|\frac{9000}{9000 - v^2}\right|$ is undefined at $v = 30\sqrt{10}$, i.e. $v = 30\sqrt{10}$ is a limiting value of $v(x)$.

- Marks continue to be lost due to premature approximation. Candidates should be encouraged to use as much accuracy as possible, thus taking advantage of the exact form often produced by the calculator.

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