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GCE Mechanics M1 (6677) Paper 1

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Mechanics Unit M1
Specification 6677

Introduction

The vast majority of candidates seemed to find the paper to be of a suitable length. The paper proved to be slightly more demanding than last summer's but seemed to provide sufficient opportunity for the weaker candidates to show what they could do and also be sufficiently demanding to stretch the more able; relatively few scored full marks. It was encouraging to see fewer candidates this time giving negative magnitudes in their answers. By far the best source of marks was question 4, with the final two questions providing the necessary discrimination at the top end. Overall, candidates who used large and clearly labelled diagrams and who employed clear and concise methods were the most successful.

In calculations the numerical value of g which should be used is 9.8, as advised on the front of the question paper. Final answers should then be given to 2 (or 3) significant figures – more accurate answers will be penalised, including fractions.

If there is a printed answer to show then candidates need to ensure that they show sufficient detail in their working to warrant being awarded all of the marks available.
In all cases, as stated on the front of the question paper, 'candidates should show sufficient working to make their methods clear to the Examiner.

If a candidate runs out of space in which to give his/her answer than he/she is advised to use a supplementary sheet: if a centre is reluctant to supply extra paper then it is crucial for the candidate to say whereabouts in the script the extra working is going to be done.

Report on individual questions

Question 1

Part (a) was usually well-answered with most using $v^2 = u^2 + 2as$ but a surprising number of candidates put u = 0 and tried to find v , instead of the other way round. In the second part, those who wrote down a quadratic equation in t usually obtained a correct equation. Solving the equation proved more problematical, however, with some using an incorrect quadratic formula ($b^2 + 4ac$ was seen a number of times) while others appeared simply to be in alien territory. Some of the better candidates obtained a quadratic with integer coefficients, factorised successfully but then lost the final A1 for an answer of 12/7.

The other popular choice was to find the velocity (±11.2) at a height of 33.6m and then go on to find the times, but it was very rare for <u>two</u> times to emerge, with almost all just using +11.2.

Question 2

In the first part, many candidates showed the velocities in the correct direction on a diagram but surprisingly many failed to realise that *Q* would be the faster particle. Most candidates could use the conservation of momentum principle to produce an equation of the form $3v_P + 2v_Q = (3\times 3) \pm (2\times 2)$, but fewer than half realised how to deal with the difference between the final speeds. Some had *P* travelling faster (1.4 and 0.4), others used *v* for <u>both</u> final speeds, found *v* = 1 then decided either that both were travelling at 1m/s or that the speeds were 1 m/s and 2 m/s , either way round.

Part (b) was rather better done with most of those obtaining wrong answers in part (a) managing to score M1A1ftA0. Only a few of those who had done part (a) correctly lost the final mark in part (b) for an answer of -7.2.

Question 3

Although unstructured, this question provided a familiar scenario and was a good source of marks for many candidates. Most chose to resolve parallel and perpendicular to the plane despite the fact that horizontal and vertical resolutions lead to a much more straightforward solution. There were the usual problems of sign errors, with the friction often acting in the wrong direction, extra *g*'s, a few sine/cosine mix ups and the usual bad algebra. Even those who had no idea how to solve their simultaneous equations could substitute *R* = 20 into one equation and find a value for *W*. A significant number of candidates resorted to finding the angle on their calculators or never mentioned sine/cosine = 0.6/0.8 thus losing the B mark and perhaps an accuracy mark. A few used *R* = 20 to find *W* then used *W* to find *R*!

Question 4

Almost all candidates scored full marks for part (a), with a few extending their graph beyond the line *t* = 84 and a very small minority leaving out *V*. Similarly the vast majority also obtained full marks in part (b). In the third part a significant number of candidates wrote down $\frac{1}{2}(5-v)20 = 90$. Sometimes it was clear that this was an attempt at finding the area of a trapezium, sometimes it was clearly the area of a triangle (occasionally accompanied by a helpful explanatory diagram) and sometimes one could not be sure. Occasionally one suspected that it was an application of the most commonly used wrong *suvat* formula $s = \frac{1}{2}(v-u)t$.

In the final part, virtually all candidates subtracted the relevant velocities and divided by the time to find the deceleration; those who found the velocity erroneously in part (c) could not achieve the final accuracy mark. This mark also required a positive value for the deceleration.

Question 5

Most candidates were able to produce two valid equations in part (a), with the majority using one moments and a vertical resolution. Occasionally g was omitted from the weight terms and, more rarely, a reaction was equated to the sum of moments; this led to a dimensionally incorrect equation and a significant loss of marks. A relatively small number of candidates misinterpreted the given information and included the supports in the wrong positions on the rod (often 1 m from the ends) while others failed to realise there were two reaction forces.

It was possible to find the value of the reaction directly by taking moments about R, but many found two equations and solved them simultaneously to find the reaction and then used it to find the value of M. A common error was to give the answer for the reaction as 313.6 which represents unjustifiable accuracy after using $g = 9.8$ (314, 310 or $32g$ were all acceptable).

Many comments in part (b) related to the concentration of mass at a point, or the weight acting through the point given; these achieved the mark. Some comments were irrelevant and just referred to, for example, weight acting downwards, or ‘enabling moments to be taken’.

Question 6

This question proved to be very discriminating, particularly part (c). There were an impressive number of correct solutions to the first two parts. A mark was often lost in part (a) due to over accuracy whilst a few got their sines and cosines mixed up and others left out g. In the second part it was rare to see an attempt at the whole system solution and too often the friction or the weight component was left out of the appropriate equation. The vast majority considered the two particles separately and most candidates who obtained correct equations were able to obtain the correct value of m without further algebraic errors. The final part proved to be considerably more difficult. Many found the speed of P when the string broke but then failed to appreciate that they had to then find the new deceleration before they could move on, with many just assuming it was g, without justification. A number of candidates had the masses the wrong way round but could still pick up the majority of the marks.

Question 7

The majority were able to find the correct bearing in part (a), but it was surprising that so many candidates firstly, seemed not to realise that bearings need to be measured from North and secondly, threw away a mark by not rounding to the nearest degree – perhaps they were rushing at the end of the paper. Others tried more exotic and totally unnecessary methods such as the cosine rule.

Except for the few who seemed to have no idea of how to work with vectors (and those who thought **PQ** meant magnitude of **PQ)** part (b) was done well. There were many who wrote down the vector **q – p** correctly and were able to score a mark– often for a correct unsimplified expression but then made errors in simplifying which sometimes then led to marks being lost in the final part.

Part (c) (i) was done successfully by most good candidates, but part (c)(ii) had a very low success rate, with most candidates simply equating the **i** and **j** components of **PQ.** This proved to be a good discriminator at the end of the paper.

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