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Mathematics 6360

MM1B Mechanics 1B

Report on the Examination

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General

The majority of candidates found the paper accessible and were able to make attempts at each question. Some candidates lost a mark by not giving their answers to three significant figures as instructed on the front cover. In questions where right-angled trigonometry was required, some candidates tried to use the sine or cosines rules, making life more difficult for themselves.

Question 1

The candidates produced many good solutions to both parts of this question, with a high proportion of the candidates gaining full marks. There were three main errors that were observed on the scripts. Some candidates did not realise that one of the particles had a negative velocity before the collision and produced equations that would have applied if the particles had both been moving in the same direction. A few candidates found the momentum after the collision, but did not divide this by the appropriate mass to find the velocity. Some candidates made algebraic or arithmetic errors. For example in part (a), some candidates gave the answer 1.25, obtained by dividing 5 by 4, instead of the correct answer of 0.8.

Question 2

The first two parts of this question were done very well by the vast majority of candidates, but part (c) caused more difficulties. In part (a), the candidates almost always drew a graph with the correct shape, but made errors on the axes. The two most common errors were to use 21 instead of 12 on the time axis and to use an incorrect value on the velocity axis. In part (b), a very small number of candidates made arithmetic errors and a few also used incorrect values.

Part (c) caused more difficulties for the candidates. There were three main incorrect approaches. The first of these was to assume that the forces on the lift were in equilibrium and hence simply state that the tension was equal to the weight, giving their answer as $2940\ \text{N}$. Some candidates used an incorrect value for the acceleration, which they then included in a three term equation of motion which would have otherwise been correct. The most common approach was to take the acceleration as $2\ \text{m}\,\text{s}^{-2}$.

A few candidates used a three term equation of motion with the correct terms but an incorrect sign. This approach would produce a result such as $T = 2940 - 150 = 2790\ \text{N}$.

Question 3

Candidates seemed to either do very well or very badly on this question, with many producing completely correct solutions. Some candidates did part (a) by finding the angle α first and then using trigonometry to find F, rather than finding F first as suggested in the question. There were some candidates who were able to form the two equations, $F\cos\alpha = 6$ and $F\sin\alpha = 5$, but who then made no progress in solving these to find either F or α. A small number of candidates did not know how to start this question and produced no working at all.

Question 4

Almost all candidates gained some marks on this question, but only a fairly small proportion gained full marks. In part (a), there were many good answers, but a number of candidates stated assumptions that were not about the string. Instead they produced comments about the block or the peg. Part (b) was generally done quite well, but there were some candidates who did not gain credit because they did not show enough working. For example, simply stating $\frac{6}{4} = 1.5$ was not sufficient. There were, in contrast, some very good solutions that fully justified the final answer.

In part (c), the candidates who considered the forces on the 7 kg sphere did quite well. The main error that these candidates made was to use $T - 7g = 7a$, rather than $7g - T = 7a$, and obtained a tension of 79.1 N. Other candidates produced equations that involved the 13 kg block but could make little satisfactory progress because they did not know the friction force.

Part (d) was the most demanding part of the question. It required the candidates to find the friction force and then to use $F = \mu R$. Some candidates worked through these stages, but there were relatively few complete solutions. The most common errors were to assume that the friction was equal to the tension and simply apply $F = \mu R$, and to try to work with a combination of both bodies instead of just the block.

Question 5

While there were many good solutions to question 5, some candidates did find parts of the question quite difficult. Part (a) was generally done very well. In part (b), some candidates found the 'wrong angle', giving an answer of $18.4°$. There was also an issue for some candidates who used their rounded answer from part (a) to obtain the angle. An example of this would be $\cos^{-1}\left(\frac{0.1}{0.32}\right) = 71.8°$; these candidates would lose the final accuracy mark. In part (c), it was very common to see candidates use the resultant velocity and the width of the river to find the time. These candidates produced the result $t = \frac{15}{0.316} = 47.5\,\text{s}$ rather than $t = \frac{15}{0.3} = 50\,\text{s}$. Part (d) was often done well, but some candidates used the constant acceleration equation $s = \frac{1}{2}(u + v)t$, with $u = 0$ and $v = \sqrt{0.1}$ or 0.316.

Question 6

In part (a) there were many good diagrams, but also a number that included extra forces, especially parallel to the slope. On some diagrams the arrows or labels were missing. Part (b) was done well and the vast majority of candidates did show enough working to gain all of the marks. Some candidates clearly used the given answer to correct their working. Part (c) was more demanding. When finding the acceleration, the main errors were not dividing the resultant force by the mass; making a sign error to obtain $a = -0.171$; not considering both forces, to produce equations like $100a = 68.4$; and not resolving the weight correctly.

In the last part, there were some good explanations, but there were also a lot that were not acceptable. Some candidates wrote about the resistance being related to the acceleration rather than the speed or velocity. A few also thought that the resistance would depend on the slope.

Question 7

Part (a) was usually done very well, but in some cases very badly. Many candidates produced good complete solutions. A few made arithmetic or algebraic errors that often resulted in the loss of the final accuracy mark. A few candidates found the time, but not the height.

Part (b) was more demanding. Some candidates did not really make any progress with this part of the question. For those that got started, the most common errors were to include a sign error in the quadratic equation that they used to find the time; and to produce a correct quadratic equation, but to make an error in finding its solutions.

Some candidates did use a two-time approach, finding the time to go up to the maximum height and the time to come down to the tree. Many of these candidates were successful, but there were problems associated with getting the right distance to use to find the time down to the tree.

Question 8

Many candidates made good attempts at parts (a) and (b). The majority of errors were due to errors made manipulating the vectors. Some candidates did write down correct equations or expressions to begin their solutions, but made errors in manipulating their expressions. In part (b), a few candidates included a $75\mathbf{i}$ term.

Several candidates simply did not attempt part (c) of the question. Of those that did, some tried to find a time using expressions for the position of the particle rather than its velocity, while other candidates tried to use the equation $v^2 = u^2 + 2as$.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the **Results statistics** page of the AQA Website.