Examiners' Report

Principal Examiner Feedback

Summer 2019

Pearson Edexcel International A Level

In Mechanics M1 (WME01/01)

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General comments:
Most candidates offered solutions to all eight questions on this paper. There were questions which proved to be accessible to all candidates, and parts of some questions that allowed the more able candidates to distinguish themselves.

Candidates who drew clearly labelled diagrams tended to give clearer, more concise solutions, and to avoid using the same name for more than one unknown. They were also less likely to omit terms from equations.

Candidates should take care in their working – it was common for candidates to be able to set up the correct equations but then to make slips in solving them.

Candidates should be reminded that for this specification, if a substitution is used for the value of g, then they should use $g = 9.8.$. Following this substitution, answers should be given to 2 significant figures or to 3 significant figures. There were several instances of candidates using $g = 9.81$.

Question 1
This question gave most candidates a very confident start to the paper, with almost two thirds of all candidates gaining full marks. In part (a) the equation for conservation of linear momentum was usually correct, but there were a few arithmetic errors in reaching the final answer. There were also a few candidates who did not reach a positive value for the speed of Q. In part (b) the impulse-momentum principle was usually applied correctly.

Question 2
Most candidates demonstrated that they could resolve vertically and horizontally and apply $F = \mu R$ to obtain a pair of correct equations involving the normal reaction and the applied force, with about half of all candidates reaching the correct answer. Some became confused about the direction of the applied force, often combining this with friction acting in the wrong direction. Some candidates created difficulties for themselves by calling every unknown force F. Other common errors included sine/cosine confusion and answers not being given to the required accuracy after the use of $g = 9.8$. A few candidates incurred an accuracy error by using $g = 9.81$.

Question 3
(a) Most candidates were successful in forming two independent equations to find the value of M and the tension in the rope attached at C. The majority used a moments equation combined with resolution of the forces acting vertically, but a few used two moments equations. A significant number of candidates lost the final accuracy mark by giving an answer to 4 significant figures following the use of a substituted value for g. A few candidates tried to avoid this problem by giving their final answer as a multiple of g, but this is not correct either because the given tension is not given as an exact multiple of g.

(b) This brought a wide variety of answers. All that was expected was a comment about the beam remaining straight. Several candidates introduced irrelevant factors such as the position of the centre of mass.

(c) Many candidates formed the moments equation and resolved successfully to produce a completely correct solution. A few candidates tried to find a different distance and then go on

to find the required distance – this approach was usually less successful. The most common error was to use a value from part (a) for the tension in the ropes.

Question 4

Some candidates were confused by the concept of an engine pushing a truck up the track. They assumed that the truck was pulling the engine. This was less of an issue in part (a), where most candidates used an equation for the whole system. It became an issue in part (b) where the driving force was sometimes attributed to the truck.

(a) Most candidates formed a correct equation for the whole system, and many obtained a correct value for the acceleration of the system.

(b) In order to find the force exerted by the coupling, it was necessary to consider either the engine alone, or the truck alone. Several candidates assumed that the coupling was in tension. It was quite common for the equation formed to include some forces for each vehicle.

Question 5

(a) Many candidates didn't seem to understand which angle they were trying to find. Many used trigonometry to obtain a relevant acute angle, but did not go on to score the second mark; they left their answers as $56.3°$ or $33.7°$. A few candidates incorrectly subtracted $33.7°$ from $180°$ instead of adding it to $90°$. This was a question where those who drew a diagram were usually more successful.

(b) Almost all candidates scored the mark for adding $\mathbf{F}_1$ and $\mathbf{F}_2$ to find the resultant force. Some candidates were able to show a clear use of the direction, either showing the resultant as a scalar multiple of the given vector and then forming and equating two equations or forming a single equation using ratios. This usually resulted in the correct equation.

The most common error was for candidates to equate the components of their resultant force to 3 and –2. Some candidates claimed to have reached the given answer without showing all the steps clearly.

Question 6

(a) Many candidates had the right idea of what to do to find the value of *U*, but they often formed an equation with inconsistent signs for the direction. The displacement and the acceleration should both be negative. Using both as positive values does give the correct answer (due to the symmetry of the motion), although it was clear that many candidates did not know why. Some candidates produced long solutions looking for the time taken to reach the maximum height and the height of this point above *A*, but they usually became confused over their own figures and did not reach the correct value for *U*. Some candidates assumed that the time given was the time to the greatest height.

b) Many candidates used $s = vt - \frac{1}{2}gt^2$ correctly and obtained the correct answer. Some preferred to find the initial speed and then used $s = ut + \frac{1}{2}gt^2$. The most common errors were due to candidates using their answer from part (a) as the initial speed of the ball after the bounce.

c) Most candidates scored at least one mark for the graph. Many were able to draw the first line correctly, although there was some confusion caused by the requirement for velocity rather than speed – some graphs showed no negative velocity at all. Some candidates started the

second line at the end of the first. Some drew the correct lines but then drew a solid line to join the two parts of the graph. Another common error was to draw curved graphs, despite using constant acceleration in parts (a) and (b). Candidates with the two correct lines usually marked the required values correctly on the axes.

Question 7

(a) Most candidates correctly applied $\mathbf{r} = \mathbf{r}_0 + \mathbf{v}t$ for both ships. The next step, subtracting to obtain $\overrightarrow{BA}$ needed to be clear and unambiguous because candidates were working towards a given answer. Some candidates made errors in using brackets, and there were several arithmetic slips in the working. Sometimes when an error was discovered the final answer was fudged, rather than the candidate working back to find the source of the error.
Although it is beyond the scope of this module, some candidates were successful in reaching the correct answer by using relative velocity.

(b) Many candidates recognised the need to use Pythagoras to find the distance between the two ships, and solve the resulting quadratic equation. The majority of quadratic equations were correct, and many candidates obtained the two times at which the ships were 2 km apart. Some candidates did not go on to find the difference between these two times.

Question 8

(a) Most candidates were successful in forming dimensionally correct equations for the motion of *P* and for the motion of *Q* and *R*. They went on to solve these to find the acceleration and the tension. Exact answers in terms of *g* were acceptable, but many candidates preferred the decimal approximations. The most common errors were to lose the factor *m* from the tension, and to give the acceleration as an exact fraction (which is not appropriate following a substitution for *g*).

(b) The responses to this question were very varied. The key point that candidates were expected to make was that they had assumed that the particles all moved with the same acceleration.

(c) Many candidates started by finding the correct value for the speed of *Q* at *A*. Some candidates did not understand that the acceleration of the system would change when *R* separated from *Q*, and incorrectly used the acceleration found in part (a). Those candidates who attempted to find the new acceleration usually formed correct equations and obtained the correct answer. Candidates then needed to use *suvat* with their speed and their acceleration to find the required distance. There were some sign errors and some slips in the algebra, but the best candidates usually reached the correct final answer.

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