Examiners' Report
Principal Examiner Feedback

Summer 2017

Pearson Edexcel International Mathematics
In Mechanics A-Level (WME01)

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General Introduction

The majority of students offered responses to all eight questions on this paper. Parts of most questions proved to be accessible to most students, and apart from the last two questions (addition of forces, and motion of connected particles) the modal score for each question was full marks.

Some students let themselves down through poor algebraic manipulation and a tendency to use premature rounding in calculations. In some cases there was no clear method being communicated, and basic formulae were apparently not known. The best work was clearly set out, and accompanied by clearly labelled diagrams.

Students should be reminded of the need to make their work clear to the examiners - some handwriting is so small that it is difficult to read. It would be helpful if students took more care in writing figures - there needs to be a distinction between 4 and 9, and it is common to see students miscopying their own 3, 5 and 8.

Students need to be reminded to read the rubric and the questions very carefully. In all cases, where a value for g is substituted, the value should be 9.8 m s^{-2}. The use of 9.81 will be penalised as an accuracy error. The rubric on the paper gives students a very clear reminder about the accuracy expected after the use of 9.8, but many students lose marks for giving too many significant figures in their final answers.

Reports on Individual Questions

Question 1

Most students were able to set up the two equations but there was some incorrect algebra at times, which meant that the final answers were often incorrect. Only a few students used the alternative method of drawing a triangle of forces. Most students linked the angles with the correct forces, although trig confusion was a common cause of errors. Some students used $5g$ in place of 5 and occasionally use of $F = ma$ with non-zero a was seen. No students attempted to resolve perpendicular to the unknown forces. A few weak students did not have two unknowns in their equations.

Question 2

(a) There were many fully correct answers to this question. Most errors were due to slips in finding distances, or dimensionally inconsistent equations with a term missing, either a distance or a force. A few students ignored the weight of the beam.

(b) Many students did start by resolving vertically to find the magnitudes of the new reactions. However, continuing with the values used in part (a) was a common problem. In forming the moments equation, some students made errors in the distances, with several using a total length of a for the rod, rather than $2a$. There were many correct solutions and several students lost only the final mark - often due to rounding errors.

Question 3

(a) Most students set up an impulse/momentum equation. Many made sign errors, especially those students who did not draw 'before and after' diagrams for the collision. There were a few 'correct' answers from initial errors with signs followed by incorrect manipulation of terms. The question asks for the speed of *P*, so the final answer must be positive.

(b) The most efficient method of answering this part of the question was to consider the impulse on *Q*; many students took this approach and obtained both answers. However, the majority chose to use conservation of linear momentum. Some students didn't think about the possibility of the particle travelling in the opposite direction, so they could not score full marks. It was common to see sign errors in the momentum equations.
Some students used CLM for one value of *m* and then an impulse/momentum equation for the other value – sometimes arriving at the same result.
Many students missed the clue in the question and did not try to find a second value.

Question 4

(a) Here again, the relationship between impulse and momentum was understood, but there were many sign errors. The question asks for the magnitude, so a positive answer was expected.
(b) The majority of students answered this correctly. However, many students did not read the question carefully enough to appreciate exactly what was going on. Several solutions involved the speed 10 m s^{-1} as well as or instead of 7 m s^{-1}.
A few students were using $g = 9.81$ and incurred an accuracy penalty.
(c) The most common approach here was to form a quadratic in *t*. Those students who thought that 10 was involved usually did not score any marks. Again it was evident that students had not read the question carefully enough to appreciate the situation, with many obtaining the correct quadratic equation but either choosing the wrong root, subtracting the roots, adding or subtracting from some other completely incorrect time or making no choice at all. Those students who had an incorrect quadratic often lost more marks by using their calculator to solve their incorrect equation rather than just showing a bit more work involving the quadratic formula.
Several students used the alternative method and thus avoided the quadratic equation.

Question 5

(a) Many students were able to draw the *v–t* graphs successfully but some students drew both lines starting at 0 rather than one at 20. There was confusion for several over where *T* should be placed with many taking this to be where *Q* reached constant speed. Also, their *T* was sometimes the required *T* but it could also be the length of time *Q* was travelling at constant speed. For many students, this part of the question was the only part attempted.
(b) This question was a simple exercise in observation/similar triangles. It was often made more involved than necessary and many solutions involved the use of *suvat* equations. Some students found that *Q* had been accelerating for 10 seconds, but did not add the 20 seconds. Several students did not interpret the point of intersection of the graphs as the answer, and there were several blank responses.
(c) Most students knew they needed to find the area under each graph. Many found a correct expression for the distance travelled by *P*. A large number of students did not realise they needed to find the time for the speed of *Q* to reach to reach 40 m s^{-1}. Students who did find this time often gave the answer as 16, not 36. Many students preferred to split each trapezium into a triangle plus a rectangle rather than use the formula for area of a trapezium. This approach gave them a more complicated expression, and more scope for errors in their algebra and arithmetic. With various *t*'s involved and, in many cases, no distinction between them, some of the work was very difficult to follow.

Question 6

This was possibly one of the easiest questions on the paper but it was clear from the responses that several students are not confident in the use of vectors.
(a) With the occasional arithmetic slip, most students made use of $\mathbf{v} = \mathbf{u} + \mathbf{a}t$ to obtain the velocity at time 6 s and went on to find a relevant angle using their velocity. Judging by the variety of final answers that were given it appears that many students do not really understand the link between the direction of the vector and the bearing. Several students did not notice that they had been asked to give their final answer to the nearest degree.
(b) Those students who correctly associated the direction of motion with the velocity of the particle often scored the first two marks for a correct expression for the velocity at time *t* seconds. Some students were not sure how to relate their velocity to the given direction, but many did correctly equate the **i** and **j** components, or stated that the ratio or these components was equal to 1, and reached the correct value for *t*.

Question 7

(a) Many students were apparently unaware that the resultant of the two forces was given by the sum of the two vectors, and were unable to make any progress with this question. Some students did attempt to use cosine rule, but often with an angle of $50°$ rather than $130°$. Those students who tried to resolve in two perpendicular directions made several errors in their working and tended to be less successful.
(b) Those students who used sine or cosine rule to find the angle often found a relevant angle, but did not actually find the angle required. Some assumed that the direction of **R** bisected the angle between **P** and **Q**. Those students who used tangent with their resolved components were often successful.

Question 8

(a) Most students demonstrated some understanding of how to approach this part of the problem, and many followed the request that they write down separate equations of motion for each particle. The equation for Q was often correct. In the equation for P, there were several trig errors, many students had a in place of $2a$ and several treated the slope as a rough surface. The values of the acceleration and tension should have been given as exact multiples of g or to a maximum of 3 significant figures - several students lost a mark through inappropriate accuracy in their answers.

(b) It was unusual to see a correct solution to this part of the problem. Many students continued with the tension found in part (a), not realising that the value of μ affects the tension. Only a few students adopted the correct strategy of using P to determine the tension and then using Q to determine the value of μ. A small number of students with correct work replaced it because they believed, incorrectly, that $\mu \leq 1$.

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