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Examiners' Report/
Principal Examiner Feedback

Summer 2016

Pearson Edexcel International A Level
in Mechanics M1 (WME01)
Paper 01

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Summer 2016
Publications Code WME01_01_1606_ER

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Parts of all questions on this paper proved to be accessible to most candidates, with relatively few completely blank responses seen. The majority of candidates scored well on the first two questions (*suvat* and impulse/momentum), but later questions provided more discrimination, with very few candidates scoring full marks in questions 3 (vertical motion), 4 (uniform rod in horizontal equilibrium) and 7 (connected particles).

There were many examples of clearly presented work, with clear diagrams and all variables defined. At the other extreme there was some work that was so untidy and disorganised that some candidates miscopied their own writing or used the same variable name for two separate quantities. Candidates should be reminded that the examiner needs to be able to read their work.

The rubric makes it very clear to candidates that if they substitute a value for g then they should be using 9.8, but it is still common to find candidates losing accuracy marks through using 9.81. Similarly, many candidates lose accuracy marks by not rounding their final answer to 2 or 3 significant figures after the use of an approximate value for g.

Question 1

This was a very familiar question for most candidates. Almost all candidates started with a correct equation for the motion in the first 4 seconds. There were then many options for a correct second equation, the most popular of which was to use the same value of u and $s = 285,\ t = 10$. The most common error at this point was to use the same value of u and $s = 219,\ t = 6$. Some candidates with a correct pair of simultaneous equations made slips in solving them.

It is possible to answer this question by considering the average speed in each interval. Although many candidates considered the average speeds, very few of them linked the speeds with the correct times.

Question 2

(a) This was a very accessible question for most candidates, with the majority achieving a correct initial equation for the conservation of linear momentum (CLM). There were some sign errors, and some candidates doubling rather than halving the initial speeds. The most common errors however occurred in simplifying the equation for CLM and solving for k - several candidates did not replace *mu* by 1 when dividing through by *mu*, leading to $k = \frac{1}{6}$.

(b) The method for finding the magnitude of the impulse was well understood, although some candidates gave a negative final answer. Candidates who made errors in finding k were still able to gain full marks in part (b) if they worked with P.

Question 3

(a) The great majority of candidates found the value of *h* correctly. As *h* is defined as the initial height above the ground, the final answer was expected to be positive.

(b) Very few candidates gave a fully correct response to this part of the question. A small proportion (c.15%) of candidates recognised the need to consider the effect of the impact between the two blocks and to form an equation for CLM.. Most candidates used *suvat* equations correctly (albeit with the incorrect initial speed), to find the deceleration while sinking into the ground. Some candidates used a distance of 12 m rather than 12 cm. Several candidates attempted to form an equation of motion to find *R*, but there were several sign errors and the weight of one or both blocks was often omitted. The sign errors - acceleration into the ground, weight acting upwards - raise questions about the candidates' understanding of the model. Several of the small number of candidates who did work through the question correctly then lost the final mark because they gave their final answer to more than 3 significant figures (having used $g = 9.8$).

Question 4

(a) Most candidates were familiar with the methods to use to find the forces acting on the plank at the two supports. The majority of successful candidates used two moments equations about *A* and *C*. Some candidates used vertical resolution and some took moments about another point. Errors in the moments equations usually involved arithmetic errors in calculating distances, but sometimes the distance was omitted, resulting in a dimensionally inconsistent equation, and there were some sign errors. Many candidates lost accuracy marks by giving the forces to 4 or more significant figures, which is incompatible with the use of $g = 9.8$.

(b) Candidates found this part of the question more difficult. It was common to find a candidate incorrectly using one of the forces found in part (a) or producing an equation for moments about *C* that was dimensionally incorrect, e.g. $30g \times 1.4 + Mg \times 3.4 = 5000$, rather than 5000 x 0.6. Some candidates were confused between the mass of the diver and the weight of the diver. Although many candidates noted that an integer mass was asked for, it was more common to see 77.7 rounded up to 78 rather than down to 77 as the context requires.

(c) The number of incorrect comments here was surprising as this is a standard modelling assumption. There were many imaginative answers and many references to "centre of mass" or "weight", but not "acting at a point".

Question 5

(a) This question proved challenging for many candidates, both because of the vector format, and because several candidates did not appreciate that they needed to add the two forces to find their resultant. The idea of parallel vectors caused difficulty for many candidates who were not entirely certain how to use this information. Those who used ratios were more successful than those who tried to set up a pair of equations. It was common to see $2+p$ equated to 1 and $q-3$ equated to 2. In order to score full marks, a candidate needed to get to the answer given in the question, and not simply to an equivalent form.

(b) For the first mark, all that was required was to substitute $q=11$ into the given equation and solve for *p*. Most, but not all, candidates scored this mark. Most candidates attempted to use $\mathbf{F}=m\mathbf{a}$ or $|\mathbf{F}|=m|\mathbf{a}|$, although weaker candidates still struggled with the vectors. Some thought incorrectly that $|F_1+F_2|=|F_1|+|F_2|$. Some candidates subtracted forces, so they did not have the correct resultant. Some candidates found the vector for the acceleration but did not go on to find its magnitude.

Question 6

(a) Almost all candidates found the value of *a* correctly.

(b) The speed-time graph should have been a routine task, but many candidates did not label *T* correctly - they did not appear to understand that 'same speed' is not the same as 'same distance', and placed *T* at the point of intersection of the two graphs. Many graphs did not extend beyond the point of intersection. Nearly all showed the correct shape for the graph for *A*. Most also had the correct shape for the graph for *B*, but if the sketch stopped at the point of intersection they scored only 1 mark out of 3.

(c) Some candidates offered no attempt to find the value of *T*, but the majority understood that they needed to form an equation to equate two areas. The work on areas was sometimes poor, with basic errors in finding the area of a triangle or of a trapezium, but those candidates with a correct graph were usually able to form a quadratic in *T* and solve it. Those candidates with an incorrect graph were also able to find *T* if they went back to the question and applied *suvat* formulae correctly. Those candidates who did solve correctly for *T* usually gave a reason for taking only $T=7$.

(d) Almost all candidates with a correct answer to part (c) scored this mark.

(e) Most candidates achieved at least two marks here. The graph for *B* and the first part of the graph for *A* were usually clear and correct. Many candidates did not make it clear that there was a second part of the graph for *A* - when a line overlaps the *t* axis then it is important to exaggerate this line. Some candidates incorrectly drew a solid vertical line connecting the two parts of the graph for *A*.

Question 7

(a) Most candidates tackled this question with confidence and knew that they needed to find equations of motion for *P* and for *Q*. However, several candidates continued with a non-zero acceleration term in both equations, apparently not understanding the term "limiting equilibrium". The correct approach is to form the two separate equations and then combine them, but some candidates applied Newton's law for motion in a straight line around the pulley. Apart from a non-zero acceleration, the most common errors were in resolving forces, and to have friction acting in the wrong direction. Although the exact value of the trig. ratios for the angles have been given, some candidates created rounding errors by working with approximate values for the angles.

(b) Several candidates showed a good understanding of how to find the magnitude of the force acting on the pulley, although they sometimes employed overcomplicated methods, usually because they had not realised that the two planes were perpendicular to each other. Some candidates considered the horizontal and vertical components and then combined them and did reach the correct value. A final answer of 22.17 was common but not correct because it follows the use of $g = 9.8$ and 4 s.f. is therefore not appropriate.

(c) The most common answer was "downwards", which was not sufficiently accurate to earn the mark. Some candidates gave the answer as a bearing, which is not appropriate in this context.

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