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# Examiners' Report/
# Principal Examiner Feedback

## January 2016

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

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## General

The paper as a whole proved to be generally accessible and there was no evidence of candidates running out of time. Most questions had parts which were very well answered but also at least one aspect which proved more challenging such as the directions of impulses in question 2, the velocity-time graph in question 4, the inequalities in question 5 and the final stage of the motion in question 7. Candidates were most successful on question 3 and question 6 was also well answered. A lack of understanding of the motion of connected bodies was evident in the first question and surprisingly, candidates achieved the least success here. 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 but exact multiples of $g$ are usually accepted. 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.

## Individual questions

### Question 1

Parts (a) and (b) were generally either “full marks” or “no marks”. As is often the case those candidates who were able to produce a force diagram with all forces labelled were in the best position to answer the question. Most realised that an equation of motion was required for the truck in part (a). Omitting the tension or the resistance on the truck or even the driving force, which was to be found, or including the resistance on the trailer, were all seen too often. The second part was generally done successfully with the simpler trailer equation being the more successful route to a solution. A particularly simple error seen was 400/0.5 = 200. Candidates who used the whole system approach were more prone to error and often hampered by an incorrect answer to part (a). For part

(c), many candidates suggested that the tension was equal instead of, or as well as, the acceleration being the same for both the trailer and the truck and candidates should be aware that extra incorrect answers will be penalised. Others did not provide enough detail by simply stating that the “acceleration is the same”.

**Question 2**

Although the impulse-momentum equation was familiar to almost all candidates, there were many sign errors in applying the equation. Often this was exacerbated by the fact that candidates failed to identify an assumed direction of motion for the particle under consideration. Some candidates gave a negative speed and this lost a mark. A number of candidates cancelled incorrectly and arrived at speeds which were not multiples of $u$ and it was disappointing that such errors were not corrected. The correct answer was more often seen in part (b) where candidates used the impulse-momentum method. Candidates who found the speed of $P$ and then attempted to find the velocity of $Q$ using conservation of momentum were successful if the velocity of $P$ had been found correctly. If this was not the case, accuracy marks were inevitably lost. In describing the direction of motion the presence of the phrase “due East “in the question should have alerted candidates to the required form for describing the direction of the particles but vague responses such as to the right, positive or **PQ** were seen. There were many excellent fully correct solutions but these were most certainly in the minority.

**Question 3**

This was a straightforward question and provided a rich source of marks for the majority of candidates. Most candidates understood the principles of resolving forces vertically and horizontally. As is always the case in questions of this type, those prepared to produce an accurate force diagram were usually rewarded by gaining most or all of the marks available. Weaker candidates who quoted $R = 8g$ were very much in the minority and there were a few algebraic slips seen but generally, this question was done well. Indeed, the most common error seen was giving the final answer to four significant figures. Other errors included trying to resolve along the direction of $T$ and using $F - T\cos 30 = ma$

and then not setting $a$ to zero. $T\sin 30$ was occasionally missed from the vertical resolution.

**Question 4**

This question involved free vertical motion of a particle under gravity. In part (a) the majority of candidates used a valid method to find the maximum height reached. There were two main alternative approaches: either the distance from the point $A$ was calculated and the result added to the (given) height of $A$, or the initial speed was found and then used in another '*suvat*' equation to calculate the required height. Occasional errors seen included not adding the height of $A$ to find the **total** height reached, sign errors in finding the initial speed, and use of $g = 9.81\ \text{ms}^{-2}$ (rather than $9.8\ \text{ms}^{-2}$ as specified on the front of the paper). Nevertheless, the correct answer (10 m) was reached by many candidates. Part (b) proved to be more challenging and a wide variety of approaches were seen. The more straightforward methods included finding the time from the highest point to the ground and then doubling, or using the initial velocity with zero displacement. A fairly common mistake was to find only part of the required time, often just that from the point $A$ or by combining only some sections of the motion. There was occasional confusion in linking corresponding displacements and velocities and some candidates made more work than necessary by calculating 'time up' and 'time down' separately (not always getting the same answers). Working was not always easy to follow; candidates might help themselves and the examiners if they specified which part of the motion they were considering. The final answer was required to be rounded to 2 or 3 significant figures following the use of $g = 9.8\ \text{ms}^{-2}$. Relatively few entirely correct velocity-time graphs were seen for part (c). If upwards was taken as positive, the required graph included a single straight line starting on the $v$-axis and with negative gradient. The most common error was to draw a '**V**' shape which represented speed rather than velocity. However, a wide variety of other combinations of lines (and even curves) were also seen which reflected a lack of understanding by many candidates. Although many achieved the mark for having a line starting at (0,11.2), few achieved the final mark for the correct intercept (1.1(4),0) on the $t$-axis.

**Question 5**

Virtually all candidates realised that it was necessary to equate moments about at least one point to find the required tensions in the ropes holding the rod. Most took moments about the point *B* to find the tension at *A*, and then moments about *A* to find the tension at *B*. Apart from occasional slips in writing down the relevant distances ($x$ or $(2.2 - x)$ instead of $(4 - x)$, for example) much good work was seen. Some preferred only to use 'moments' once and then find the other tension from a vertical resolution equation. This was a perfectly valid method but it did mean that an error in the first tension resulted in a wrong answer for the other tension as well. Only a very small number of candidates wrote dimensionally incorrect equations. It was rare to see moments equated about any other points although such equations could lead to correct answers. In part (b) most candidates realised the expressions for tensions had to be compared to the maximum value (84N), but not all attempted a comparison for both tensions. Occasionally the inequality was written the wrong way round and so the final answer did not represent the required range of possible values of '$x$'. Some achieved the method marks but lost accuracy through previous errors in the tensions. Those who identified the critical values correctly often lost the final mark by using strict inequality signs rather than including the possibility of equality. Nevertheless, there were an encouraging number of entirely correct solutions seen.

**Question 6**

This question proved highly successful for the majority of candidates. In part (a) most were able to subtract the two position vectors and then apply Pythagoras' theorem leading to a correct result either in surd or decimal form (to at least two significant figures). The two most common errors were adding the vectors and then applying Pythagoras, resulting in one out of the three marks being awarded, or leaving the vector **PQ** as their final answer and not finding its magnitude and this also scored one out of three. A few found the moduli of **OP** and **OQ** and subtracted them and this gained no credit. In parts (b) and (c) most students were able to find the two position vectors in terms of *t*. Part (d) was well done with most of the successful candidates forming and solving two equations. Some solved one equation and then tested it in the other. To obtain the last mark a time of 2.24pm or 1424 was required. In the final part candidates

were very successful in substituting their value of $t$ and arriving at the correct position vector. However it needed to have come from a single value of $t$ in part (d) to gain both marks available.

**Question 7**

This question was generally well answered. In parts (a) and (b) most candidates applied Newton's Second Law successfully to each particle producing the required two equations. Using a whole system approach received no credit since the question asked for equations of motion for *each* particle. In the third part, most were able to obtain the normal reaction and then use it to find the friction force, using $F=\mu R$, and then solve their equations to find the acceleration and the tension. The final part provided some discrimination at the top end. Most realised that they needed to find the speed of the particles when the string breaks but not all found the new deceleration of $P$. Those that didn't were unable to make further progress. Of those that did, most were able to find a correct distance but a few then forgot to add on a further 0.5m.

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