Examiners' Report
Principal Examiner Feedback

January 2017

Pearson Edexcel International A-Level
Mechanics M1 (WME01)

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General

Overall this proved to be an accessible paper that provided a good test of students' understanding of mechanics. Time did not seem to be a limiting factor on performance with mostly full attempts at all of the questions and there were few blank responses seen. Question 1 (kinematics), Question 4 (moments) and Question 6(b) (equilibrium of a particle on an inclined plane) were particularly well answered with full marks often awarded. There were also many good responses seen to the first parts of Question 7 (pulley and connected particles) although the later parts proved to be challenging and the final part was accessible to only the best of the students. Although there was evidence of a fair understanding of vectors in component form in Question 2(a) and 2(b), the implication of the parallel vectors in Question 2(c) was not always recognised. The vectors in non-component form in Question 3 were not well understood with many students unable to add two vectors together correctly. Question 5(b) too proved to be challenging for a number of students who were unable to successfully deal with the two possible directions of motion of *P*. In addition, despite this problem being raised in previous reports, some students continue to lose marks due to accuracy issues either through premature approximation or due to *g* issues. 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 students 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, students should show sufficient working to make their methods clear to the examiner. If students run out of space in which to give their answer then they are advised to use a supplementary sheet – if a centre is reluctant to supply extra paper then it is crucial for the students to say where in the script the extra working is going to be done.

Question 1

Most students made a good attempt at the first part although there were arithmetic errors and some forgot to add all three times together. There were some instances where students would obtain a negative time due to an earlier error, but ultimately ignore the negative sign in their final answer. In part (b) the majority were able to make a good attempt at the distance by considering the area under their graph but if a time had been missed in part (a) then often part of the area was also omitted here. Most used the three separate parts with some using areas but many using *suvat* equations. Only a small number made use of the trapezium rule, which was much simpler. Some students chose to give the distance as 3680. In the final part, the average speed was usually calculated using a correct method but there was a surprisingly large number of students who just found the mean of the initial and final speeds.

Question 2

In part (a) many, having obtained a correct vector for **a**, went on unnecessarily to find its magnitude, not realising that acceleration is a vector quantity. There were problems with division by 0.5 for some students and a small number only found the magnitude and never a vector. On the other hand in the second part many students found only the velocity vector but failed to progress to the speed. A few tried to work with the magnitudes and unsurprisingly got nowhere. In part (iii) most students were unable to form the initial equation. Many worked with displacement rather than velocity or used the vector found in part (b) or used the force instead of the acceleration or set the velocity components equal to 2 and 1 respectively and little progress was made.

Question 3

Students found this question more challenging. Most students chose to use the cosine rule, with solutions using resolution of forces in two perpendicular directions being in the minority. The most common error was to use an angle of 120° rather than 60°. A few simply summed their components rather than using Pythagoras. A few students who resolved the forces either added the horizontal components or ignored the horizontal component of **Q**. Some incorrect angles were found using the sine rule, with 6 being used rather than 7.

Question 4

The usual errors were made in this question with students failing to tell examiners which point they were taking moments about, using incorrect distances or omitting forces. In part (a) most students chose to take moments about one point and to resolve vertically. The most common problem where the method was correct was to give the final answer to an inappropriate degree of accuracy. Students who had struggled in part (a) sometimes redeemed themselves in the second part. The majority chose to resolve vertically first and then take moments. A small number of students used their reactions from part (a) leading to a heavy loss of marks. Errors in lengths and arithmetic slips caused most of the problems and the occasional use of 9.81 rather than 9.8 resulted in an inexact distance being found. Some rounded their values during working and ended up with $AE = 5.76$. In the final part very few correct responses were seen. Many stated that a weight acted at a point or equivalent but very few specified a point.

Question 5

In part (a) virtually all students attempted to apply the correct formula for impulse in terms of difference in momenta. Some did not take into account the change in direction of Q (leading to a sign error) and a very small number gave the magnitude as $-3kmu$ rather than $+3kmu$. Perhaps surprisingly the answer '$2kmu + kmu$' was not always simplified correctly. Occasionally the impulse on P was calculated; in this instance marks were not awarded since the direction of P after impact had not been specified in the question and the answer was required in terms of u, k and m. Most students wrote down a valid conservation of linear momentum equation in the second part. Although there were two possible directions of motion for P after collision, the majority only considered one (usually direction unchanged) and therefore only found one possible value for k. Alternatively some equated impulses but a sign error often led to the incorrect answer of $k = -4/3$. Some knew there should be a second answer so just stated +/- their calculated value with no justification. Those who recognised that were two alternative directions generally found the values of k correctly but these students were in the minority.

Question 6

Some very good solutions were seen for both parts of this question. In part (a) the error seen most often was to use $F = ma$ with F as the friction force, rather than the resultant force. After finding the acceleration almost all used a valid '*suvat*' method to calculate the required speed but rounding errors sometimes led to an inaccurate final value. Following the use of $g = 9.8$, only answers rounded to 2 or 3 significant figures are acceptable. If the answer is presented to 3 significant figures, then these figures must be correct to secure the accuracy mark. In the second part many students were able to resolve correctly (and almost invariably in the directions parallel and perpendicular to the slope). Occasionally the component of the weight was omitted in the parallel resolution and sometimes the frictional force was included with the wrong sign. A few students used their reaction or friction force from part (a) which showed a lack of understanding and resulted in a significant loss of marks. There were some errors in the solution of the simultaneous equations but nevertheless there were a fair number of correct answers seen. Again, the comments about accuracy are relevant. Although 'over accurate' answers following the use of $g = 9.8$ are only penalised once per question, inaccurate answers are penalised each time they occur.

Question 7

In the first part, the vast majority of students used a correct equation of motion for *P* and subsequently derived the given value for the acceleration. They then repeated the method for *Q* in part (b) and, apart from an occasional numerical slip, found the correct value for *m*. Part (c) was also completed with a fair degree of success. Occasionally *g* rather than the calculated acceleration was used in a '*suvat*' equation, but generally a valid method was employed successfully. Sometimes rounding errors appeared in those solutions which employed two '*suvat'* equations. Part (d) required consideration of the motion after *Q* hit the ground; most realised that the calculation of the speed at the point of impact was relevant. Not all, however, also appreciated that since *P* was now moving freely under gravity the deceleration was 9.8 m s^{-2} and not 1.4 m s^{-2} as calculated previously. Many who used a correct method failed to achieve the final mark because they did not add the calculated time ($\frac{\sqrt{15}}{7}$) to the original time ($\sqrt{15}$) to obtain a value of 4.4 or 4.43 for T_2. Several who did perform the addition lost the final mark by obtaining the value 4.42 as a result of rounding errors. The sketch graph in the final part was rarely awarded the two available marks. A whole range of shapes were seen including curves and trapezia. Those students who showed some understanding of the situation often produced graphs with a gradient change from positive to negative at T_2 (corresponding to a speed-time rather than a velocity-time graph). Some included a solid vertical line at T_3. Labelling was often incomplete with '-5.42' commonly omitted from the *v*-axis.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

http://qualifications.pearson.com/en/support/support-topics/results-certification/grade-boundaries.html

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