Examiners' Report
Principal Examiner Feedback

Summer 2017

Pearson Edexcel GCE
In Mechanics M1 (6677/01)

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General

The vast majority of students seemed to find the paper to be of a suitable length, with no evidence of students running out of time. Students found the paper very accessible, with all students able to make substantial progress on all questions. Question 6 was particularly well answered with 75% of students scoring full marks and almost 70% of students achieved full marks on questions 1 and 4, despite their lack of structure. Question 5, the final mark in question 3 and the last two parts of question 8 discriminated well at all levels including at the top end. Students who used large and clearly labelled diagrams and who employed clear, systematic and concise methods were the most successful.
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 and correct answers without working may not score all, or indeed, any of the marks available.
If a student runs out of space in which to give his/her answer than he/she is advised to use a supplementary sheet – if extra paper is not used then it is crucial for the student to say whereabouts in the script the extra working is going to be done.

Question 1

This was a good starter for the majority of students and full marks were common. Both column vectors and the use of **i** and **j** were seen. Most equated the sum of the three given vectors to zero (either explicitly or implicitly), obtained two equations in p and q and solved them. Students would be advised to check their solutions as often their equations were correct but their values for p and q were not. Some responses showed a lack of understanding that it was the sum of the *components* that needed to be equated to zero and **i** or **j** were sometimes included in their equations throughout. Most errors were made by those who did not fully grasp the concept of equilibrium and they equated the sum of two of the forces to the third. This resulted in students scoring one mark out of a possible six. A few tried working with magnitudes but were not successful.

Question 2

In part (a), virtually all students attempted to apply the principle of conservation of linear momentum to this collision problem but, although equations were almost invariably dimensionally correct, there were occasional sign errors. The equivalent method of equating magnitudes of impulses was only rarely seen. It was fairly common to see the final answer left as '$-2u$' but since speed (which is positive) was required this was penalised. Sometimes the use of 'xu' as a variable led to confusion as to whether this velocity was x or xu with the answer sometimes given as 2 (rather than $2u$). In the second part, most interpreted correctly the sign of their velocity and made a clear statement that the direction was reversed although a small number just wrote 'yes' or 'has changed'. This mark was only available if the conclusion followed from a correct velocity found previously. Almost all used a correct equation for impulse, in the final part, although occasionally 'g' was included or 'm' was omitted. Sign errors were more prevalent but there were, nevertheless, many correct answers seen. Although the majority of students chose to calculate the impulse on P, this did depend on a velocity calculated previously. Finding the impulse on Q might have been the more sensible option since both relevant velocities were given in the question. The magnitude of the impulse was required; most students recognised this and gave a positive answer. However, a few interpreted the magnitude of '$-12mu$' as just 12 rather than $12mu$. There were a significant number of students who worked out the impulse for both particles to check that their response was correct.

Question 3

This moments question was generally done well and many achieved full marks for part (a). Most students chose to resolve vertically and take moments about a point (usually point *A*) which led to an efficient solution. One of the more common errors seen was forgetting to include the length in the term with $5R$ when taking moments about *A*. This made the equation dimensionally incorrect and resulted in a significant loss of marks. Far fewer used two moments equations; this inevitably complicated the algebra and consequently the chance of error in finding the value of x. Any accuracy greater than 2 significant figures was acceptable for the final answer but it is important that an answer is correct to the chosen accuracy; an answer of 2.26 (rather than 2.27 to 3 significant figures) was penalised. In the second part, most students presented one correct explanation of the assumptions, namely that 'uniform' implies the centre of mass is at the plank's midpoint. However, many failed to realise that the significance of the 'rod' in this context is that it does not bend (or is rigid). Realising that there were two marks available, most attempted to explain a second assumption; this was often either not relevant (such as treating people as particles or that 'forces up equal forces down') or a description of what uniform means.

Question 4

This question involving equilibrium of a particle on an inclined plane was also well done by the majority of students. Almost all resolved parallel and perpendicular to the plane. A few omitted the component of '10N' in the perpendicular resolution and there was very occasional sin/cos confusion. A very small number of students obtained incorrect values for $\sin\alpha$ and $\cos\alpha$ (i.e. using $\sin\alpha$ as 4/5 and $\cos\alpha$ as 3/5 or using sin(3/5) and cos(4/5)). The correct strategy of dividing the frictional force by the reaction to find the coefficient of friction was widely recognised. Friction taken in the wrong direction led to a negative value for μ although that did not always seem to alert students to their mistake. Nearly all rounded their answer to 2 or 3 significant figures which is appropriate following the use of $g = 9.8$ and full marks were often awarded.

Question 5

This questioned proved to be the most challenging for the students. There were some correct solutions showing an awareness of what forces were acting and where and in which direction they were acting and a clear diagram was key to the solution of this problem. Two equations of motion were required and students either considered each particle separately and/or the whole system. It is evident that a significant number of students have struggled with the concept of thrust and there was a great deal of confusion in some of the solutions. This is clearly something that needs greater emphasis and practice in the classroom. Some students had the 15N force acting on the wrong particle and these lost marks as a result.

Question 6

This question was very well answered by the vast majority of students. Most used $s = vt - \frac{1}{2}at^2$ in the first part but a significant minority found u first and then found a. The value of u was then used in part (b). The most common errors were mistakes in the *suvat* formulae themselves, particularly use of $s = vt + \frac{1}{2}at^2$ instead of $s = vt - \frac{1}{2}at^2$ or incorrectly using $s = ut + \frac{1}{2}at^2$. Use of $u = 0$ or $u = 10$ was also seen in both parts. Arithmetic errors such as use of $^5/_4$ instead of $^4/_5$ were also seen. The second part of the question was more problematic than the first. Those who recognised the need to calculate a value for u usually completed the solution successfully and many students had already calculated u in the first part. A significant number of students did not show working when solving their quadratic equation and so the mark for solving was sometimes lost when incorrect solutions were found. Most students recognised the need to specify which value of t was the correct one. Students who used the second alternative approach usually ended up with $t = 2.192$ but some then forgot to adjust it to give the required time. A few graphical approaches were also seen in either or both parts and these were usually successfully completed.

Question 7
This high scoring question was a good source of marks for most students, particularly the first three parts. Part (a) was answered well with students showing that they were able to use an appropriate trig. ratio to gain the first two marks. Responses which used a diagram to find the bearing tended to be more successful. Almost all found a correct acute angle and went on to calculate the bearing as 103 but a few didn't round to the nearest degree. The second part was answered well by the majority of students although a few mistakenly interchanged the position and velocity vectors. Part (c) involved a printed answer and most students did show clear method and stages of working in using **p** – **q.** A few equated the position vectors **p** and **q** and received no credit. A small minority, who had correct working, failed to copy the printed answer exactly and so lost the final A mark. The final part tended to be all or nothing with those who realised that Pythagoras was required usually scoring all of the marks. Occasional errors in squaring brackets were seen and some omitted $t = 0$ as a possible solution or eliminated it as a viable answer.

Question 8
In part (a), most students found an equation of motion for *A* and an equation of motion for *B*. Sign errors were rare and it was a case of either full marks or no marks, with relatively few picking up anything inbetween. Some students struggled with 'an equation of motion' and gave a list of *suvat* equations instead. The majority scored full marks in the second part, with many having already used $F = 2mg\mu$ in part (a). The answer was printed and so inevitably an incorrect expression sometimes morphed into a correct one. Whole system approaches for those that scored zero in part (a), often paid off. Many students who did not understand what was required in part (a) and either left it blank or produced *suvat* equations, then wrote the correct equations in part (b) to complete this part. The vast majority of students obtained a correct expression in part (c), although a few forgot to square root and a few did not use the printed answer for the acceleration given in part (b). In the fourth part, a significant number of students misunderstood the scenario and continued to use the earlier value of a ($^{g}/_{9}$ or $^{49}/_{45}$ being common), which meant that no marks were available. Others used m rather than $2m$ in the new equation of motion for *A*. Those who did find a new acceleration were sometimes undone by using $s = d$, forgetting the distance already travelled, and lost a mark. In the final part the majority of correct responses stated that 'the particle(s) would not move'. Less common was 'the particles would remain in equilibrium or limiting equilibrium'. Some scored this mark having very little else correct for this question and whether this was from using the given expression in part (b) or a guess was not clear. Common incorrect answers were that d would be less or that the particles would stop sooner. Some students appeared to be under the impression that μ was changing from $^{1}/_{3}$ to ½ whilst motion was in progress.

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