Examiners' Report

Summer 2014

Pearson Edexcel International Advanced Level in Mechanics M2 (WME02/01)

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Mathematics Unit Mechanics 2

Specification WME02/01

General Introduction

The paper discriminated well at all levels and there were some impressive, fully correct solutions seen to all questions. Generally, students who used large and clearly labelled diagrams and who employed clear, systematic and concise methods were the most successful.

As clearly stated on the front of the question paper, in calculations the numerical value of g which should be used is 9.8 and final answers should then be given to 2 or 3 significant figures – more accurate answers will be penalised, including fractions.

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.

Question 1

In Q01(a) most students scored full marks although a few tried to use *suvat*. Having integrated, only a handful failed to find the constant. In the second part almost all knew that they needed to set $v = 0$ and solve the resulting quadratic. It was rare to find incorrect answers for t and all gave an answer for t_1 that was less than t_2, with the majority using factorisation.

In Q01(c) most students knew that they had to integrate. Some included a constant and stated that it was equal to zero while the majority used limits. There were a few who integrated between 1 and 1.5 and then 1.5 and 2 or between 0 and 1 and 0 and 2. Many used the correct limits of 1 and 2 but then added their answers instead of subtracting. There was a minority who clearly showed their intention of integrating between 1 and 2, got the answer $-\frac{1}{6}$, changed the sign to $\frac{1}{6}$ but did not show any working.

Question 2

There were many fully correct solutions in Q02(a), although a common error was to subtract the components of the weights of the vehicles when resolving, so losing accuracy marks. Most wrote an equation for the whole system. Some omitted the weight components and a few seemed to think that F was the resultant force and did not include an ma term in their equation. Virtually all students scored the M mark for $P = Fv$ but many gave an over-accurate answer and so lost the final A mark. In the second part, the majority of students tried to write an equation of motion for the car or trailer alone and included T, but many had a sign error with the component of the weight and a few used 400 N as the resistance.

Question 3

The majority scored the first two marks in Q03(a), although some used the wrong trigonmetric ratio or omitted sin or cos from one side of their equation. A significant number did not show values for $\frac{\cos 30}{\sin 60}$ or $\frac{\cos 60}{\sin 30}$ and so, since this was a ‘show that’ question, lost the last A mark. There was less success in the second part. Resolving horizontally and vertically was the most popular method, while a few resolved parallel and perpendicular to the rod. However, some tried to resolve W in their vertical equation. Many students failed to realise that they needed to find two perpendicular components of the force at A and just assumed that it acted along the rod. A few tried to take moments about D, the midpoint of the rod or even B, but tended to omit one of the components of the force at A. Some worked out the horizontal and vertical components correctly in terms of W, used Pythagoras to find the resultant but then omitted W from their final answer.

Question 4

This question was found to be challenging. In Q04(a), many students treated the shape as a square minus a triangle and did not realise that the triangle was folded over. Consequently, they used the total mass as $11.5a^2$ and only scored the second B mark and first M mark. Some tried to work backwards from the given answer, but then gave up. Some omitted *a* from their answer. However, many students did give the correct answer, usually by splitting the shape into 2 rectangles and 2 triangles but some subtracted the triangle from the square and then added it back in the correct, folded position. One or two worked out the centre of mass of the pentagon and then added on the folded triangle. In the second part, many students did not realise that they needed y (bar). Some used a second moments equation to work it out instead of using symmetry – some took moments about *AE* to get the distance required to find the angle. However, very few students used a correct denominator in the expression for the tangent of the angle. Many did not draw a diagram to help them identify the correct triangle and distance. A few gave their answer in radians.

Question 5

This proved to be a challenging question which required careful management of vector and scalar equations and completely correct solutions were rarely seen. Nearly all students attempted to write down an impulse-momentum vector equation for the system and most were successful. To make progress it was now necessary to extract from this vector equation the two scalar equations and this caused considerable difficulty with two correct equations rarely seen. Many wrote down equations which were a mixture of vectors and scalars making any progress impossible. Others attempted to equate the magnitudes and the equation $K\sqrt{2} = 0.5(15 - 12)$ was often seen.

For the minority who were successful in extracting two scalar equations, those who eliminated θ first (resulting in a quadratic in *K*) were generally much more successful than those who eliminated *K* first, since solving a quadratic is a more routine process than solving an equation of the form $a\cos\theta - b\sin\theta = c$.

Question 6

This was an accessible question and was well answered. In Q06(a) almost all students correctly formed both the momentum and restitution equations and the vast majority were then able to go on to obtain the required result. A few students looked to be working back from the given answer. Many students failed to draw a diagram and left it to the examiners to determine the directions of motion and the attribute of symbols.

Q06(b) was the most challenging part of the question. Sign errors were common, as was a misunderstanding of the inequality that was required, with some setting their velocity for Q to be less than their initial velocity for P. Mistakes in algebraic manipulation were frequent here and many students struggled to deal with the inequality $\frac{(27-k)}{(k+3)} < 0$. A few restarted the question with P moving in the reverse direction to that in Q06(a), but more often than not there were errors in the restitution equation and very few were successful following this approach.

In the final part, the majority of students successfully found the velocities required and attempted to find the loss in KE with some students producing clear, complete and succinct answers. Others lost marks by dropping the m or the u^2 towards the end of the solution, a few added rather than subtracted energies, some failed to put $k = 7$ and a few decided that e was still $\frac{1}{9}$.

Question 7

In Q07(a) most students made a reasonable attempt at an energy equation with the majority giving an acceptable decimal answer. The final mark was lost by those who left their answer as a fraction despite using the approximation $g = 9.8$ and a minority who left their final answer as -1.68 also lost the final mark. There was a significant number that did not use an energy method and so gained no credit for what were otherwise correct solutions.

In the second part, the majority of students appreciated that the minimum speed occurred at the apex of the path and produced a correct solution. However a significant number were confused by the question and started to investigate the vertical component and made no progress, others equated $4\sin\alpha$ to 2.5 and it was unclear if this was an error or a misunderstanding.

Students found Q07(c) the most challenging part of the question. The vast majority used $s = ut + \frac{1}{2}at^2$ to find the time of flight but a lot of errors were evident with incorrect signs on their displacement *s* or an incorrect vertical component of velocity where sometimes the speed was used instead of a component with $u = 4$ (or even 7). Having set up the quadratic equation in *t*, it was rare to see any method shown for its solution with answers for *t* simply written down. Students should be reminded that method marks will be lost in such circumstances and to gain credit there must be evidence, via the quadratic formula or otherwise, as to how answers were obtained with calculator facilities simply used as a check. To find the time of flight, a very small minority produced a solution by finding the vertical speed at *B* using $\sqrt{(7^2 - 2.5^2)}$ and thus avoided a quadratic by using '$v = u + at$'. Those students who had obtained a value of *t* did usually use this value correctly in attempting to find the horizontal distance between *A* and *B*.

Grade Boundaries

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

http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

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