Examiners' Report/ Principal Examiner Feedback

Summer 2010

GCE

Mechanics M1 (6677)

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Publications Code UA024468

Mechanics Unit M1
Specification 6677

Introduction

The paper seemed to be of a suitable length for the vast majority, although because the last part of the last question was very discriminating it wasn't always clear whether weaker candidates were running out of time or running out of ideas. The paper did prove to be of an appropriate standard, providing not only stretch and challenge at the top end but also allowing weaker candidates at the bottom end to demonstrate what they could do. The very high SD (19.7/75) of the mark distribution provided convincing evidence of this. In many cases candidates seemed to have great problems applying principles of mechanics in slightly unfamiliar scenarios, showing a lack of real understanding. Many candidates do not realise that a magnitude must be a positive number and many do not understand the difference between speed and velocity. The first question proved to be a problem for many of the candidates along with Q8, especially the final part, and Q7. The best sources of marks were Q6 and Q2. Overall, candidates who used large and clearly labelled diagrams and who employed clear 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.

If candidates run out of space in which to give their answer than they are 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.

Report on individual questions

Question 1

This proved to be a tricky opening question for many of the candidates. The most popular approach was to find the starting position and then use it to find the position vector at $t = 2$. Errors in sign were fairly common at some stage of the working. A significant minority did not use a valid method at all, some just multiplying the given velocity vector by 2 or using a time of 6 only, and others becoming confused with constant acceleration formulae. A number of candidates failed to find the magnitude of their position vector to obtain the distance as required; there were follow through marks available for this even if the vector had been determined incorrectly. A few found the distance from the starting point rather than from the origin. Nevertheless, there were a fair number of entirely correct solutions.

Question 2

This question produced very many correct responses. In part (a) most candidates were able to apply the conservation of momentum principle with few problems, with many candidates achieving all four marks. As usual a significant number, maybe fewer than in previous years, made sign errors, with the occasional candidate missing the odd 'm's or 'u's. Very few put 'g's into the equation while others had difficulty in manipulating the fractions Arithmetic errors in working out the value of k were not uncommon and negative values obtained for k seldom alerted the candidates to a possible error in their work. In the second part, the majority of candidates chose to use the change in momentum of P with many correct answers being obtained. However there were the inevitable errors with signs, more than in part (a), with too many candidates thinking that a negative answer was acceptable, misunderstanding the meaning of 'magnitude'.

Question 3

Many candidates scored well on this question. Most resolved in the horizontal direction correctly, with the occasional introduction of an acceleration term at first. In most cases this was equated to zero and most candidates were able to score the method marks at least. The mark for use of limiting friction was obtained by most. For the vertical resolution, the most common errors were either for mistakes in sign or else to state that $R = mg$, omitting the component of the 100N force. Very few candidates solved for the weight rather than the mass. Accuracy errors were common, with 12.57 being a common, too accurate, answer.

Question 4

This question was well answered, particularly by those who resolved vertically to produce one of their equations. Those who took moments about two different points had a higher failure rate, partly because of the need to represent more lengths in terms of x and partly because of the heavier algebra required. Most had the R and $3R$ the right way round, and few were tempted to swap over Tom and Sophie. There were seven significant points on the beam, and the candidates between them took moments about all seven. The least successful seemed to be those who took moments about Tom's position, which generally led to errors in the distances. A few took moments about a point but equated the sum of the moments to the reaction at the point producing a dimensionally incorrect equation and losing all the marks for that equation. It was rare to see g's being used.

Question 5

A large number of entirely (or almost) correct solutions were seen to this question. Most candidates drew their velocity-time graphs correctly and included appropriate annotations, with the most common error being that the lines drawn did not cross. This did not deny candidates access to full marks in the rest of the question though and many went on to solve the problem correctly. Most realised that they needed to equate the expressions for area under the graph to 800 for both P and Q. Attempts to use constant acceleration formulae over the whole distance were occasionally seen and scored no marks although a few used this approach in a valid way for the separate parts of the motion. Most commonly, a combination of rectangles and triangles were used to represent area rather than the area of a trapezium which made the subsequent algebra more difficult, and there were occasional errors seen in simplification. A relatively common error was to calculate a correct time for Q (t =30) but to misinterpret this as the time when they both came to rest leading to errors in the motion of P.

Question 6

This question was generally well done and often a useful source of marks for weaker candidates. Virtually all used a valid method to find the greatest height although not all added on the '49' to take account of the starting level. Those who did often failed to give their answer to an appropriate degree of precision (2 or 3 significant figures having used $g = 9.8$). Part (b), which involved finding the velocity at ground level, was also largely successfully completed although there was occasional confusion about which figure for height to use. To find the time of flight in part (c), many candidates split the motion into up/down stages and were largely successful. Those who tried to use the whole motion sometimes made sign errors.

Question 7

This question proved to be a good discriminator. The most popular approach was to resolve parallel and perpendicular to the plane (rather than horizontally and vertically which was much easier and avoided having to use simultaneous equations). The majority of candidates used $F = \mu R$ appropriately. Some, however, just equated the reaction to a weight component thereby simplifying the equations considerably and losing a significant number of marks. Candidates who did set up simultaneous equations correctly sometimes had difficulty in solving them to find the correct values for R and P, with poor use of brackets and algebraic manipulation contributing to this. A fairly common error was to give R in terms of P instead of calculating a numerical value for it. The final answers were required to be rounded to 2 or 3 significant figures for consistency with the use of $g = 9.8$ but this was not always observed and incurred a one mark penalty for the question.

Question 8

In parts (a) and (b), most were able to make a reasonable attempt at two equations of motion, but there were errors in signs and solutions. This was not helped by the fact that T was asked for first rather than a and some candidates lost marks due to trying to solve for T first rather than the easier route of solving for a. A few attempted the whole system equation and these solutions were in general less successful than those who used two separate equations to start with. In the last part, too many candidates were unable to visualise the situation clearly and then deal with it in a methodical fashion. If they failed to find both the velocity of A on impact with the ground and the distance that it had travelled they were unable to progress any further. Only the more able students managed correct solutions. Of those that managed to progress in part (c), there were sign errors which caused problems. Many chose to split the motion of B into two parts and these were usually quite successful provided that the extra distance travelled by B in the upward direction was taken into account.

Grade Boundary Statistics

The table below give the lowest raw marks for the award of the stated uniform marks (UMS).

Module		Grade	A*	A	B	C	D	E
		Uniform marks	90	80	70	60	50	40
AS	6663 Core Mathematics C1			59	52	45	38	31
AS	6664 Core Mathematics C2			62	54	46	38	30
AS	6667 Further Pure Mathematics FP1			62	55	48	41	34
AS	6677 Mechanics M1			61	53	45	37	29
AS	6683 Statistics S1			55	48	41	35	29
AS	6689 Decision Maths D1			61	55	49	43	38
A2	6665 Core Mathematics C3		68	62	55	48	41	34
A2	6666 Core Mathematics C4		67	60	52	44	37	30
A2	6668 Further Pure Mathematics FP2		67	60	53	46	39	33
A2	6669 Further Pure Mathematics FP3		68	62	55	48	41	34
A2	6678 Mechanics M2		68	61	54	47	40	34
A2	6679 Mechanics M3		69	63	56	50	44	38
A2	6680 Mechanics M4		67	60	52	44	36	29
A2	6681 Mechanics M5		60	52	44	37	30	23
A2	6684 Statistics S2		68	62	54	46	38	31
A2	6691 Statistics S3		68	62	53	44	36	28
A2	6686 Statistics S4		68	62	54	46	38	30
A2	6690 Decision Maths D2		68	61	52	44	36	28

Grade A*

Grade A* is awarded at A level, but not AS to candidates cashing in from this Summer.

- For candidates cashing in for GCE Mathematics (9371), grade A* will be awarded to candidates who obtain an A grade overall (480 UMS or more) *and* 180 UMS or more on the total of their C3 (6665) and C4 (6666) units.
- For candidates cashing in for GCE Further Mathematics (9372), grade A* will be awarded to candidates who obtain an A grade overall (480 UMS or more) *and* 270 UMS or more on the total of their best three A2 units.
- For candidates cashing in for GCE Pure Mathematics (9373), grade A* will be awarded to candidates who obtain an A grade overall (480 UMS or more) *and* 270 UMS or more on the total of their A2 units.
- For candidates cashing in for GCE Further Mathematics (Additional) (9374), grade A* will be awarded to candidates who obtain an A grade overall (480 UMS or more) *and* 270 UMS or more on the total of their best three A2 units.

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