# Examiners’ Report/
# Principal Examiner Feedback

Summer 2013

GCE Mechanics M2 (6678)
Paper 01R

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**Mechanics M2 (6678R)**

**Introduction**

Most candidates offered responses to all of the questions in this paper. Some very elegant responses were seen, usually accompanied by clear diagrams with variables being clearly and uniquely defined. Candidates should not underestimate the value of a clear diagram. Incorrect solutions with no diagram and no explanation of what the candidate was trying to do are not likely to gain any credit. When naming forces on a diagram candidates should choose a system which they themselves will not find confusing – it is not unusual to find two unknown forces both being given the same name. Similarly, candidates who use *u* and *v* as unknown speeds frequently interchange the names or combine terms incorrectly because they can not tell which is which.

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.

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 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.

If a candidate runs 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**

In part (a) those candidates who realised that they needed to start with an equation for the motion of the car and caravan combined had little difficulty with this question. Most errors were due to the omission of forces, or equations which included all the forces but only the mass of one vehicle.

In part (b) many candidates completed this part successfully; by considering the equation of motion for the caravan, the solution is independent of the work in (a).

**Question 2**

This question specifically asks the candidates to use the work-energy principle, so solutions using the *suvat* equations scored no marks. Most candidates did consider all three elements, kinetic energy, potential energy and work done against the resistance, but some made sign errors in forming their equation, and some omitted the initial kinetic energy. There are still too many candidates including both the work done against gravity and the change in potential energy, apparently not realising that these are the same thing.

**Question 3**

In part (a) almost all candidates found the times when *P* is at rest correctly.
For part (b) most candidates recognised the need to integrate to find displacement, but few understood the hint available from their answer to (a) which should have told them that the total distance travelled would not be the same as the displacement.

**Question 4**

In part (a) some candidates did not give clear explanations to justify why $AC = 4a\tan 60$, usually because they did not identify the right angle triangle formed by using the centre of the circle on the diagram given.

In part (b) candidates needed to form and use three separate equations by resolving or taking moments. In the better solutions these equations were clearly labelled, but it was often necessary to guess what the candidate was trying to do. A clearly labelled diagram showing the labels and the directions of the forces acting helped to avoid errors. Some candidates formed sufficient equations but could not find a way to use their equations to find the value of $\mu$. Although it is inconceivable that the rod might slip upwards and to the right, several candidates did have friction acting in the wrong direction, and friction did not always seem to be acting parallel to the direction of motion if the rod were to slip.

**Question 5**

Although it has been unusual to start an impact question with an equation about kinetic energy, most candidates started part (a) by writing down equations for conservation of momentum and for the kinetic energy after the collision, and using these to form a quadratic equation to find the speed of *Q*. A few candidates assumed that both candidates had the same mass in their energy equation. Having found two possible solutions for the velocity of *Q*, some candidates continued with both, not realising that it was not possible for the velocity of *P* to be greater than the velocity of *Q*. Knowing that they wanted a positive value for *e*, candidates working with the wrong pair of velocities usually contrived to reach a positive answer, when the negative answer arising from their values if they worked through correctly could have warned them of their error.
Many candidates are so accustomed to starting impact equations by forming equations for conservation of momentum and use of the impact law that it was common to see approaches to this question which started by finding the speeds of *P* and *Q* after the collision in terms of *e* and *u*, and using these to form a quadratic equation in *e* before going back to determine the speed of *Q*.
Candidates often made slips in their algebra, resulting in equations with incorrect and very untidy roots.

**Question 6**

For part (a) the majority of candidates saw this as a large triangle with a small triangle removed. Despite being told that the mass of the trapezium was $\frac{5M}{9}$ some candidates struggled to find the mass of the small triangle. Nearly all used the position of the centre of mass of a triangle correctly, and the given answer was often reached correctly. A popular alternative approach was to split the trapezium in to a rectangle and two identical right angled triangles.

In part (b) despite their success with part (a) many candidates struggled to combine the two shapes in an alternative formation. A common error was for the masses of the two pieces not to add up to the mass of the original triangle.
For part (c) most candidates were able to identify the required triangle, but it was common to see errors in the length of $\frac{1}{2}DE$ .

**Question 7**

In part (a) almost all candidates started correctly, with equations for the horizontal and vertical displacement of the ball, and went on to use these to form an equation in $\theta$. Several candidates were not able to complete the final step to reach an equation in $\tan\theta$.

In part (b) the solutions of the given quadratic equation were usually correct.
For part (c) those candidates who knew how to find the value of $\cos\theta$ found this straight forward, but several candidates resorted to approximate values in their attempt to derive an exact answer.

In pat (d) candidates were free to choose their own approach here, but those who elected to consider energy were usually more successful than those who took the *suvat* approach. There were many slips in finding the horizontal and vertical components of speed and combining these using Pythagoras' theorem.

**Grade Boundaries**

Grade boundaries for this, and all other papers, can be found on the website on this link:
http://www.edexcel.com/iwant to/Pages/grade-boundaries.aspx

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