

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	



General Certificate of Education  
Advanced Level Examination  
June 2013

# Mathematics

# MM05

## Unit Mechanics 5

Friday 21 June 2013 9.00 am to 10.30 am

**For this paper you must have:**

- the blue AQA booklet of formulae and statistical tables.

You may use a graphics calculator.

**Time allowed**

- 1 hour 30 minutes

### Instructions

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Write the question part reference (eg (a), (b)(i) etc) in the left-hand margin.
- You must answer each question in the space provided for that question. If you require extra space, use an AQA supplementary answer book; do **not** use the space provided for a different question.
- Do not write outside the box around each page.
- Show all necessary working; otherwise marks for method may be lost.
- Do all rough work in this book. Cross through any work that you do not want to be marked.
- The **final** answer to questions requiring the use of calculators should be given to three significant figures, unless stated otherwise.
- Take  $g = 9.8 \text{ m s}^{-2}$ , unless stated otherwise.

### Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

### Advice

- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- You do not necessarily need to use all the space provided.



J U N 1 3 M M 0 5 0 1







QUESTION  
PART  
REFERENCE

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QUESTION  
PART  
REFERENCE

**Answer space for question 3**

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QUESTION  
PART  
REFERENCE

**Answer space for question 4**

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QUESTION  
PART  
REFERENCE

**Answer space for question 5**

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QUESTION  
PART  
REFERENCE

**Answer space for question 5**

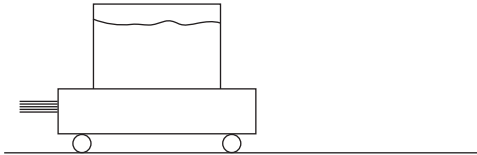
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- 6** An inventor creates a vehicle that is propelled by pumping water out of the back of the vehicle. The water is expelled from the back of the vehicle by a pump mounted inside the vehicle. The water is expelled horizontally at a speed of  $U \text{ m s}^{-1}$  relative to the vehicle. The total mass of the vehicle and the water in the vehicle is  $m \text{ kg}$  at time  $t$  seconds after the water starts to be pumped out of the vehicle. The velocity of the vehicle at time  $t$  is  $v \text{ m s}^{-1}$ .

Assume that no resistance forces act on the vehicle.



- (a)** Show that, while the water is being expelled from the vehicle,

$$m \frac{dv}{dt} = -U \frac{dm}{dt} \quad (4 \text{ marks})$$

- (b)** The mass of the vehicle, excluding the water, is  $M \text{ kg}$ . Initially, the vehicle is at rest and it contains  $M \text{ kg}$  of water. The water leaves the vehicle at a constant rate of  $\lambda \text{ kg per second}$ .

- (i)** Find  $v$  in terms of  $M$ ,  $U$ ,  $\lambda$  and  $t$ . (7 marks)
- (ii)** Find, in terms of  $U$ , the speed of the vehicle when it runs out of water. (3 marks)

QUESTION  
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REFERENCE

**Answer space for question 6**



QUESTION  
PART  
REFERENCE

**Answer space for question 6**

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