

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
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7	
8	
TOTAL	



General Certificate of Education  
Advanced Level Examination  
June 2012

# Mathematics

# MM2B

## Unit Mechanics 2B

Thursday 21 June 2012 1.30 pm to 3.00 pm

**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.



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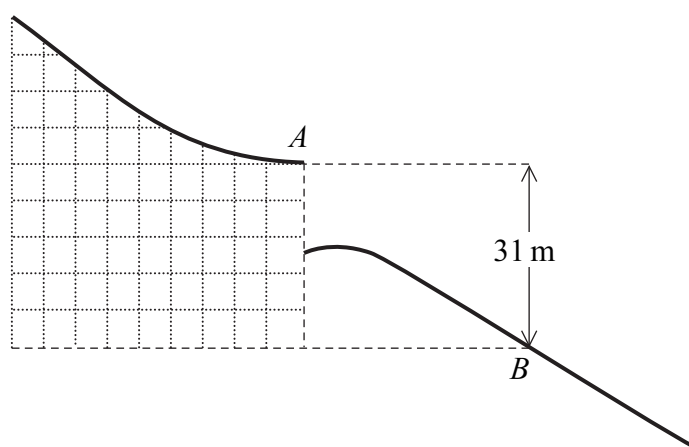
Answer **all** questions.

Answer each question in the space provided for that question.

- 1** Alan, of mass 76 kg, performed a ski jump. He took off at the point  $A$  at the end of the ski run with a speed of  $28 \text{ m s}^{-1}$  and landed at the point  $B$ .

The level of the point  $B$  is 31 metres vertically below the level of the point  $A$ , as shown in the diagram.

Assume that his weight is the only force that acted on Alan during the jump.



- (a) Calculate the kinetic energy of Alan when he was at the point  $A$ . (2 marks)
- (b) Calculate the potential energy lost by Alan during the jump as he moved from the point  $A$  to the point  $B$ . (2 marks)
- (c) (i) Find the kinetic energy of Alan when he reached the point  $B$ . (2 marks)
- (ii) Hence find the speed of Alan when he reached the point  $B$ . (2 marks)

QUESTION  
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REFERENCE

**Answer space for question 1**



QUESTION  
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QUESTION  
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QUESTION  
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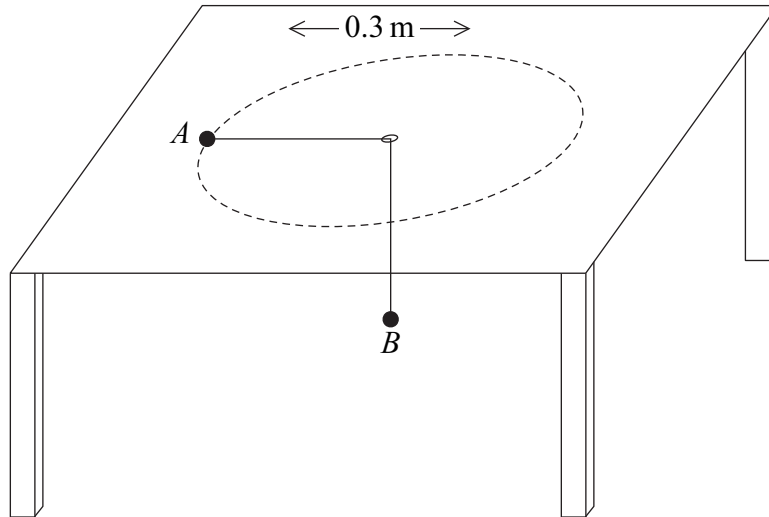
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- 5** Two particles,  $A$  and  $B$ , are connected by a light inextensible string which passes through a hole in a smooth horizontal table. The edges of the hole are also smooth. Particle  $A$ , of mass  $1.4\text{ kg}$ , moves, on the table, with constant speed in a circle of radius  $0.3\text{ m}$  around the hole. Particle  $B$ , of mass  $2.1\text{ kg}$ , hangs in equilibrium under the table, as shown in the diagram.



- (a) Find the angular speed of particle  $A$ . (4 marks)
- (b) Find the speed of particle  $A$ . (2 marks)
- (c) Find the time taken for particle  $A$  to complete one full circle around the hole. (2 marks)

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QUESTION  
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QUESTION  
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QUESTION  
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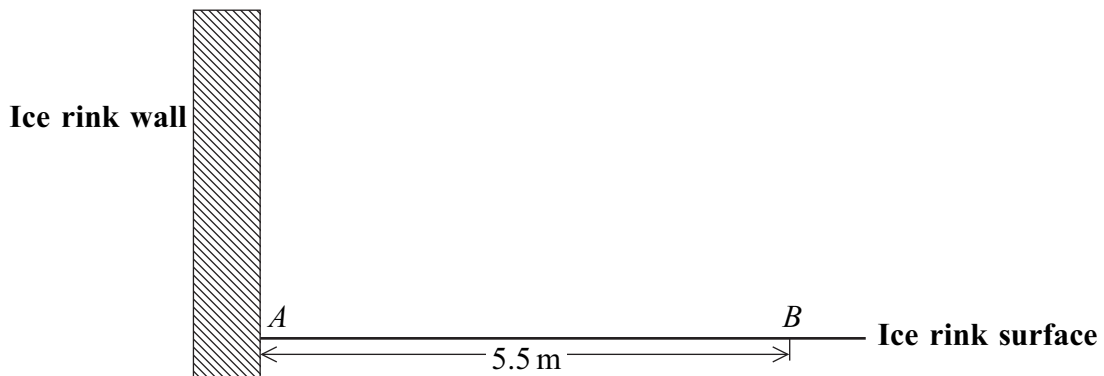
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- 8** Zoë carries out an experiment with a block, which she places on the horizontal surface of an ice rink. She attaches one end of a light elastic string to a fixed point,  $A$ , on a vertical wall at the edge of the ice rink at the height of the surface of the ice rink.

The block, of mass  $0.4 \text{ kg}$ , is attached to the other end of the string. The string has natural length  $5 \text{ m}$  and modulus of elasticity  $120 \text{ N}$ .

The block is modelled as a particle which is placed on the surface of the ice rink at a point  $B$ , where  $AB$  is perpendicular to the wall and of length  $5.5 \text{ m}$ .



The block is set into motion at the point  $B$  with speed  $9 \text{ m s}^{-1}$  directly towards the point  $A$ . The string remains horizontal throughout the motion.

- (a)** Initially, Zoë assumes that the surface of the ice rink is smooth.

Using this assumption, find the speed of the block when it reaches the point  $A$ .

*(4 marks)*

- (b)** Zoë now assumes that friction acts on the block. The coefficient of friction between the block and the surface of the ice rink is  $\mu$ .

- (i)** Find, in terms of  $g$  and  $\mu$ , the speed of the block when it reaches the point  $A$ .

*(6 marks)*

- (ii)** The block rebounds from the wall in the direction of the point  $B$ . The speed of the block immediately after the rebound is half of the speed with which it hit the wall.

Find  $\mu$  if the block comes to rest just as it reaches the point  $B$ .

*(6 marks)*





QUESTION  
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QUESTION  
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