



Rewarding Learning

ADVANCED SUBSIDIARY (AS)  
General Certificate of Education  
2014

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## Mathematics

Assessment Unit M1

*assessing*

Module M1: Mechanics 1

[AMM11]



MONDAY 19 MAY, MORNING

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### TIME

1 hour 30 minutes.

### INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number on the Answer Booklet provided.

Answer **all seven** questions.

Show clearly the full development of your answers.

Answers should be given to three significant figures unless otherwise stated.

You are permitted to use a graphic or scientific calculator in this paper.

### INFORMATION FOR CANDIDATES

The total mark for this paper is 75

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

Answers should include diagrams where appropriate and marks may be awarded for them.

Take  $g = 9.8 \text{ ms}^{-2}$ , unless specified otherwise.

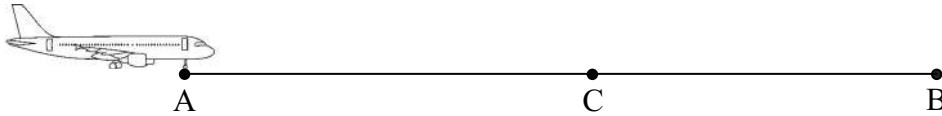
A copy of the **Mathematical Formulae and Tables booklet** is provided.

**Answer all seven questions.**

**Show clearly the full development of your answers.**

**Answers should be given to three significant figures unless otherwise stated.**

- 1** Fig. 1 below shows an aircraft about to take off along a runway AB which is 3 km long. The aircraft starts from rest at a point A and accelerates at  $1.8 \text{ ms}^{-2}$  to a take-off speed of  $72 \text{ ms}^{-1}$  at the point C.



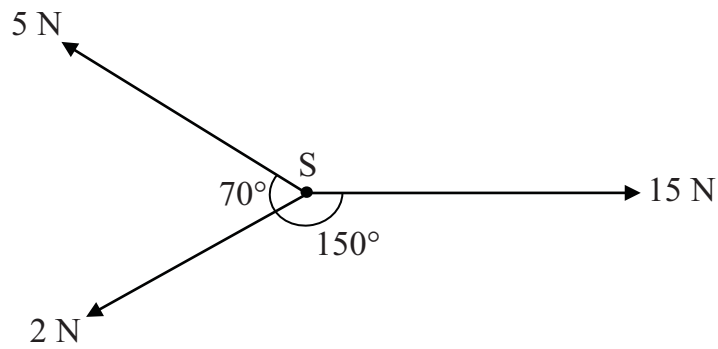
**Fig. 1**

- (i) Find the time taken for the aircraft to accelerate from A to C. [2]
- (ii) Find the distance AC. [2]

The aircraft reaches its take-off speed at C, but due to a technical fault the pilot has to abort take-off, and decelerates to bring the aircraft to rest at the point B.

- (iii) Find, in  $\text{ms}^{-2}$ , the deceleration of the aircraft from C to B. [3]

- 2 Three boys are each pulling on a school bag, S, with forces of magnitudes and directions as shown in **Fig. 2** below.  
All forces are concurrent and horizontal.



**Fig. 2**

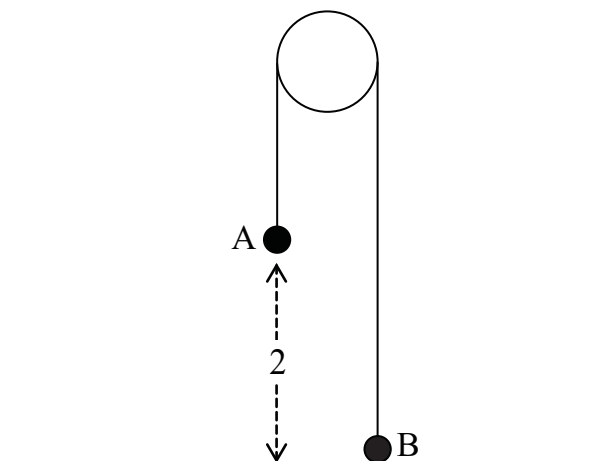
- (i) Find the magnitude of the resultant force on S. [6]

The mass of the school bag is 4 kg.

- (ii) Find the acceleration with which S starts to move. [2]

- (iii) Find the direction in which S moves. [2]

- 3 **Fig. 3** below shows two particles A and B attached to the ends of a light inextensible string which passes over a smooth fixed pulley. A has mass  $m_1$  kg and B has mass  $m_2$  kg where  $m_1 > m_2$ . Initially, A is suspended 2 m above a horizontal surface, and B is on the surface. The string is taut.



**Fig. 3**

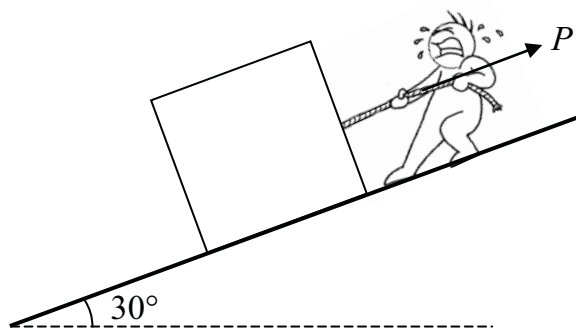
The particles are released from rest.

- (i) Given that the particle A hits the horizontal surface at  $3 \text{ ms}^{-1}$ , find the acceleration of the system. [2]
- (ii) Draw a diagram showing the external forces acting on A and B. [2]

While the string is taut, the tension in the string is 15.1 N.

- (iii) Find  $m_1$  and  $m_2$  [5]

- 4 **Fig. 4** below shows Mark trying to pull a box of mass 100 kg up a rough inclined slope. The slope is inclined at an angle of  $30^\circ$  to the horizontal and the coefficient of friction between the box and the slope is 0.4. Mark pulls a rope attached to the box with a constant force  $P$  newtons which acts up and parallel to the slope.

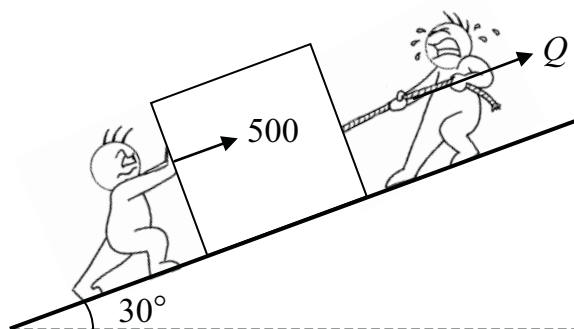


**Fig. 4**

The box is on the point of sliding **down** the slope. Model the box as a particle.

- (i) State one modelling assumption you are going to make about the rope. [1]
- (ii) Draw a diagram showing the external forces acting on the box. [2]
- (iii) Find  $P$ . [7]

Bert now joins Mark to help him move the box up the slope. Bert pushes the box with a force of 500 N up and parallel to the slope, as shown in **Fig. 5** below. Mark pulls the rope in the same direction as before, but now with a force of  $Q$  newtons.

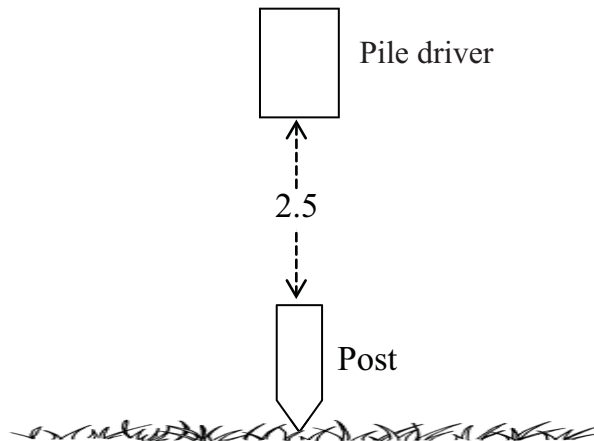


**Fig. 5**

The box is now on the point of sliding **up** the slope.

- (iv) Find  $Q$ . [3]

- 5 A vertical post of mass 9 kg is to be driven into the ground. A pile driver of mass 75 kg is released from rest from a height of 2.5 m vertically above the top of the post, as shown in **Fig. 6** below.



**Fig. 6**

When the pile driver hits the post, they remain in contact throughout the subsequent motion.

- (i) Show that the pile driver hits the post with a speed of  $7 \text{ ms}^{-1}$  [2]

- (ii) Find the speed of the post as it enters the ground. [3]

After the impact, the combined mass comes to rest after 0.256 seconds.

- (iii) Find the magnitude of the constant resistance exerted by the ground. [6]

- 6 A particle  $P$  moves along a straight horizontal line such that its velocity  $v \text{ ms}^{-1}$  at any time  $t$  seconds,  $t \geq 0$ , after passing a fixed point  $O$ , is given by

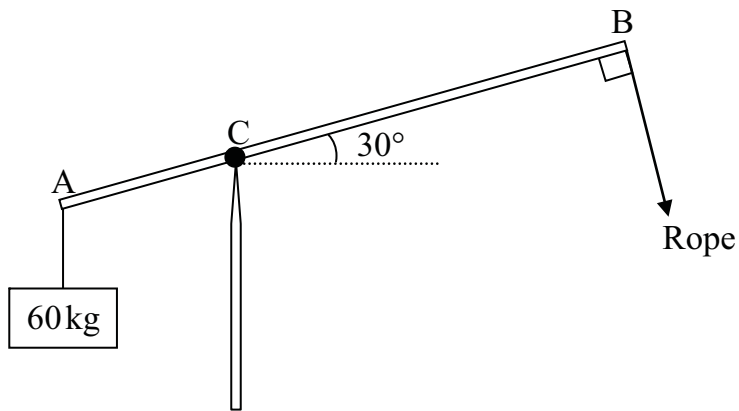
$$v = 2t^2 - 7t + 3$$

- (i) Find the values of  $t$  at which the particle comes to rest. [3]

- (ii) Find the minimum velocity of  $P$ . [6]

- (iii) Sketch the velocity–time graph for  $P$  in the interval  $0 \leq t \leq 4$  [3]

- 7 **Fig. 7** below shows a uniform beam AB of length 8 m and mass 30 kg. The beam is smoothly hinged to a vertical post at the point C where  $AC = 3$  m. A mass of 60 kg is attached to the end A. A rope is attached to the end B and held at right angles to the beam. The beam makes an angle of  $30^\circ$  with the horizontal.



**Fig. 7**

The system is in equilibrium.

- (i) Draw a diagram showing the external forces acting on the beam. [2]
- (ii) Find the tension in the rope and the magnitude of the reaction at C. [11]

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**THIS IS THE END OF THE QUESTION PAPER**

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