Rewarding Learning

Centre Number

Candidate Number

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2018

Mathematics

Assessment Unit M1
assessing
Module M1: Mechanics 1

AMM11

[AMM11]
TUESDAY 29 MAY, MORNING

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer **all seven** questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete in black ink only. **Do not write with a gel pen**.
Questions which require drawing or sketching should be completed using an H.B. pencil.
All working should be clearly shown in the spaces provided. Marks may be awarded for partially correct solutions. **Answers without working may not gain full credit**.
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.
A copy of the **Mathematical Formulae and Tables booklet** is provided.
Throughout the paper the logarithmic notation used is $\ln z$ where it is noted that $\ln z \equiv \log_e z$

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

1 A ball of mass 0.25 kg falls vertically and hits horizontal ground with a speed of $11\,ms^{-1}$
The ball rebounds vertically with a speed of $7\,ms^{-1}$
Model the ball as a particle.

(i) Find the impulse exerted on the ball by the ground during the impact. [3]

During the impact, the average force between the ball and the ground is 40 N.

(ii) Find the length of time for which this impact lasts. [2]

[Turn over

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2 Parcels are being loaded from a storage shelf onto a trolley 2.5 m vertically below the shelf.
Kate releases a parcel from rest and it falls vertically 2.5 m onto the trolley, as shown in **Fig. 1** below.

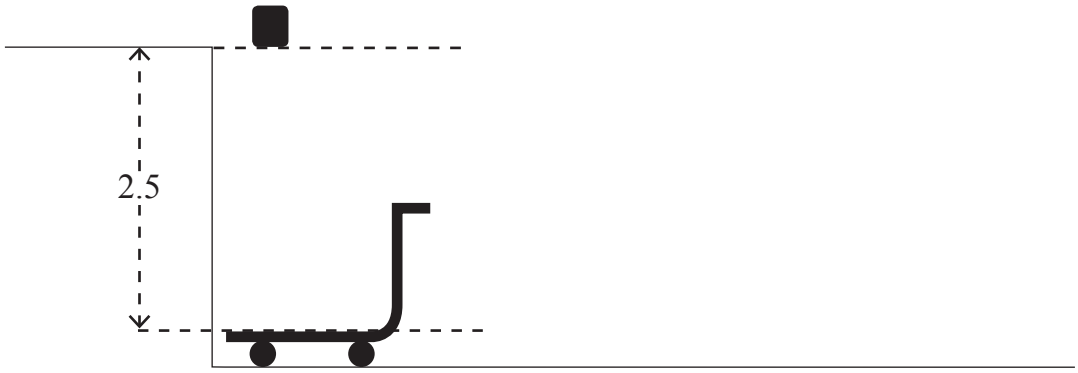

Fig. 1

(i) Calculate the time taken for this parcel to fall onto the trolley. [3]

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[Turn over

Noticing that parcels are often damaged when they are loaded this way, Kate constructs a ramp so that the parcels can slide onto the trolley as shown in **Fig. 2** below.

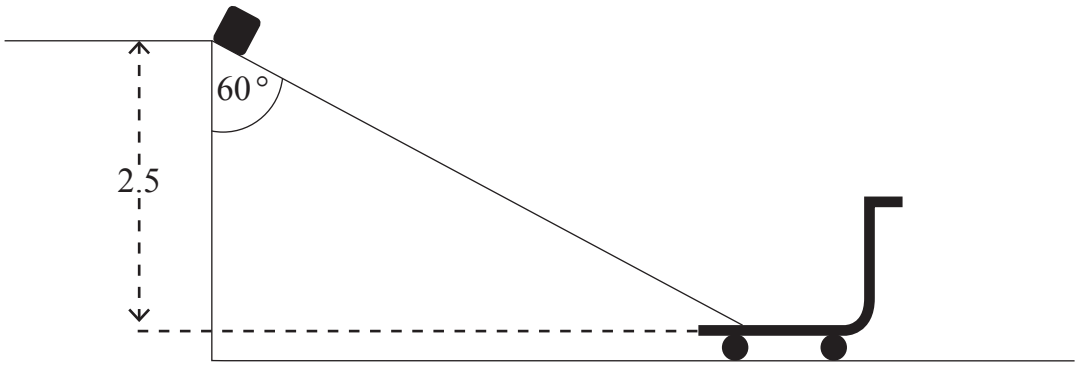


Fig. 2

The ramp is inclined at an angle of 60° to the vertical, and the coefficient of friction between the ramp and the parcel is 0.2
A parcel of mass 2 kg is released down the slope.

(ii) In the space below draw a diagram showing the external forces acting on this parcel. [2]

(iii) Calculate the acceleration of this parcel while it is sliding down the ramp. [6]

3 A non-uniform plank AB of length 4 m and mass 16 kg is pivoted at its midpoint.
Two girls, Sara and Eleanor, have mass 25 kg and 30 kg respectively.
Sara stands at end A of the plank and Eleanor stands at end B, as shown in **Fig. 3** below.

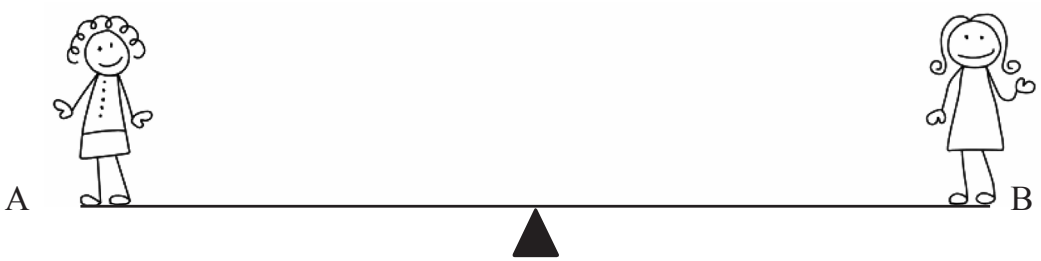


Fig. 3

The plank rests in equilibrium.
The distance of the centre of mass of the plank is x metres from A.
Model the two girls as particles.

(i) In the space below draw a diagram showing the external forces acting on the plank. [2]

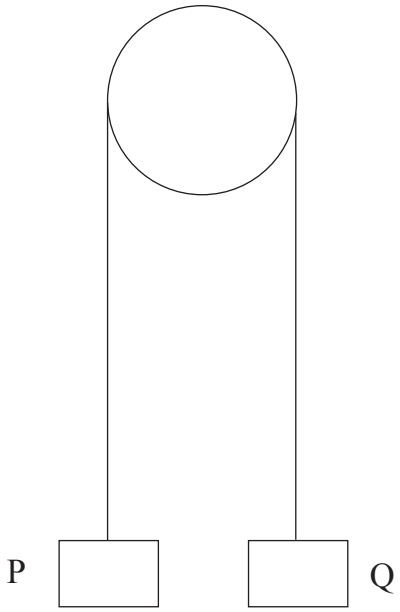
(ii) Find x. [6]

(iii) State one modelling assumption you have made about the plank. [1]

[Turn over

4 Two particles P and Q, of masses 4 kg and 6 kg respectively, are connected by a light inextensible string.
The string passes over a smooth fixed pulley.
Initially, P and Q are at the same level and are held at rest 2 m above a horizontal plane.
The system is released from rest.

(i) On the diagram below show the external forces acting on P and Q. [2]



(ii) Show that the acceleration of this system is $\frac{g}{5}ms^{-2}$ [5]

(iii) Find the velocity of P as Q hits the ground. [2]

(iv) Find the total distance moved by P before it comes instantaneously to rest. [4]

5 The velocity v ms^{-1} of a particle at time t seconds is given by

$$v = 9 - t^2$$

The particle travels in a straight line and passes through a fixed point O when $t = 2$

(i) Find the initial displacement of the particle from O. [4]

(ii) Find the distance the particle travels from its initial position until it changes its direction of motion. [5]

(iii) Find the acceleration of the particle when $t = 5$ [3]

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6 A wooden plank AB has mass $4m$ and length $4a$.
A force of magnitude T acts at right angles to the plank at B as shown in **Fig. 4** below.

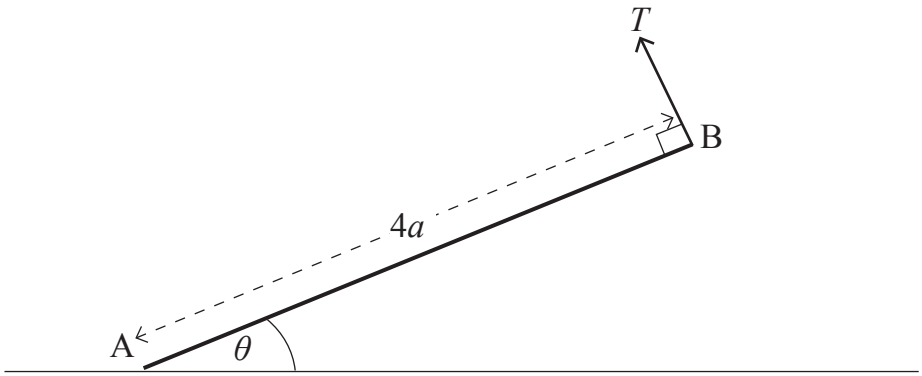

Fig. 4

The end A is freely hinged to horizontal ground.
The plank makes an angle of θ with the horizontal, where $\tan\theta = \frac{3}{4}$

The plank is modelled as a uniform rod lying in a vertical plane.

(i) State how you will use the modelling assumption that the plank is uniform. [1]

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(ii) In the space below draw a diagram showing the external forces acting on the plank. [2]

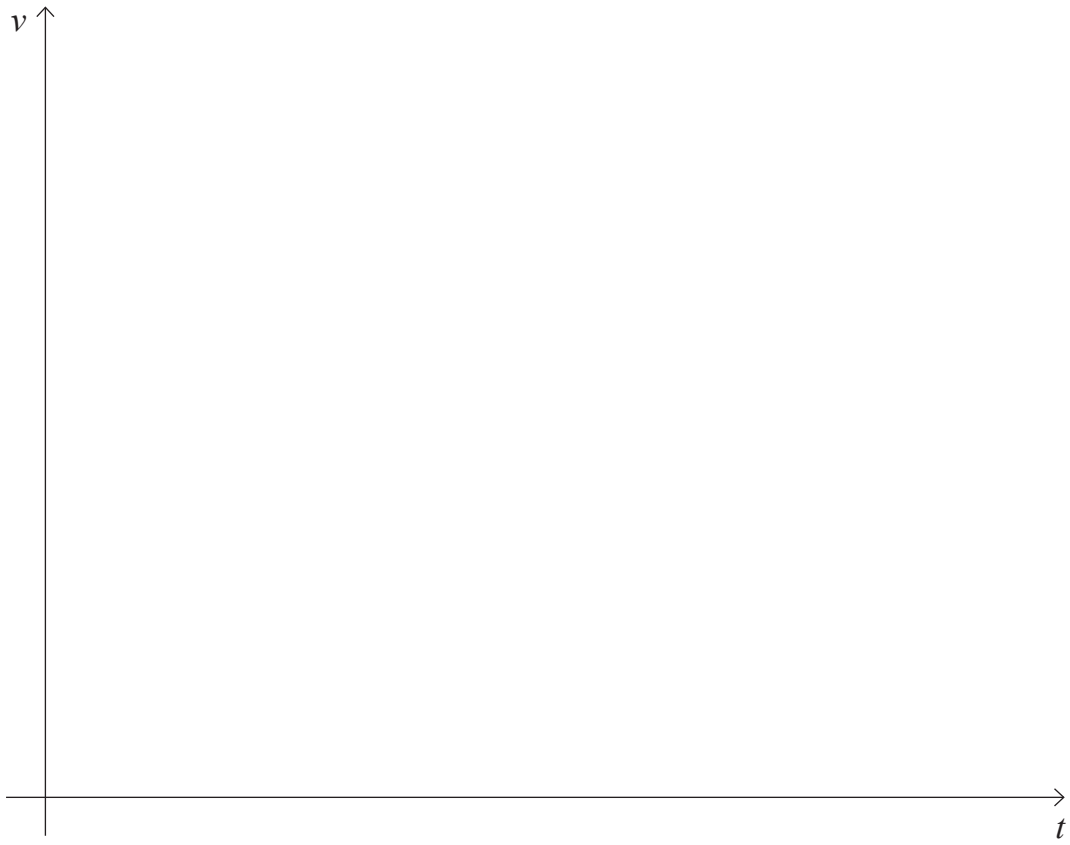
(iii) Find T in terms of m and g. [4]

(iv) Given that $m = 8\,\text{kg}$ and $g = 10\,\text{ms}^{-2}$, find the magnitude of the reaction at the hinge. [6]

[Turn over

7 Alan and Bill are in their cars and both cars are travelling at $18 ms^{-1}$ in the same direction along a straight horizontal road.
At time $t = 0$ seconds, Bill is 14.5 metres ahead of Alan.
At $t = 0$, Bill starts to brake with a constant retardation of $6 ms^{-2}$
At $t = 0.5$ seconds, Alan starts to brake with a constant retardation of $4 ms^{-2}$

(i) On the axes below sketch the velocity–time graphs for the two cars. [3]



(ii) Find the value of t at which the cars collide. [9]

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For Examiner's use only	
Question Number	**Marks**
1	
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