



Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
January 2010

Mathematics

Assessment Unit M1

assessing

Module M1: Mechanics 1

[AMM11]



WEDNESDAY 20 JANUARY, AFTERNOON

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number on the Answer Booklet provided.
Answer **all eight** 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 $g = 9.8 \text{ m s}^{-2}$, unless specified otherwise.
A copy of the **Mathematical Formulae and Tables booklet** is provided.

Answer all eight questions.

Show clearly the full development of your answers.

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

- 1 A box of mass 3 kg is being pulled by a horizontal rope along a rough horizontal surface as shown in **Fig. 1** below.

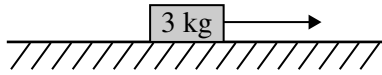


Fig. 1

The coefficient of friction between the box and the surface is 0.2
The box is moving at a constant speed.

Find the force exerted on the box by the rope.

[6]

- 2 A small ring R, of mass 0.15 kg, is threaded on to an inextensible string. The ends of the string are attached to two fixed points A and B on the same horizontal level as shown in **Fig. 2** below.

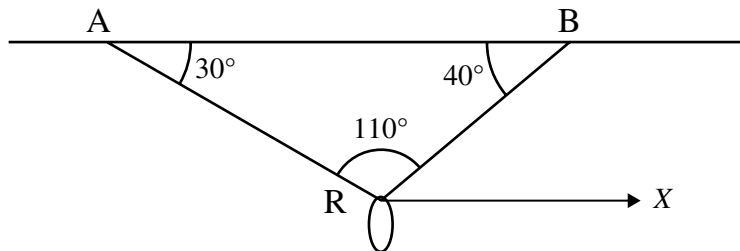


Fig. 2

A horizontal force of magnitude X newtons acts on the ring.
When the system is in equilibrium

$$\begin{aligned}\hat{B}\hat{A}R &= 30^\circ \\ \text{and } \hat{A}\hat{B}R &= 40^\circ\end{aligned}$$

- (i) Draw a diagram showing the external forces acting on R.

[2]

- (ii) Find the tension in the string and hence find X .

[7]

- 3** Two marbles A and B are moving directly towards each other on a smooth horizontal surface.
A has mass 0.4 kg and speed 1.4 m s^{-1}
B has mass 0.6 kg and speed 0.8 m s^{-1}
They collide and after the collision B has speed 0.6 m s^{-1} and its direction of motion is reversed.

Find the speed and direction of motion of A after the collision. [6]

4 Take g to be 10 m s^{-2} in this question.

A lorry of mass 6000 kg is ascending a hill inclined at an angle θ to the horizontal, where $\sin \theta = \frac{3}{5}$

The resistance to the motion of the lorry is 140 000 N.
The lorry has a deceleration of 2 m s^{-2}

(i) Draw a diagram showing the external forces acting on the lorry. [2]

(ii) Find the tractive force produced by the lorry's engine. [5]

- 5** A particle P is moving so that its velocity, $v \text{ m s}^{-1}$, after t seconds is given by

$$v = 3t^2 - 4t$$

Initially P is at rest and is a displacement of 3 m from a fixed point O.

(i) Find v when $t = 1$ [1]

(ii) Find an expression for the displacement of P from O at any time t . [4]

(iii) Find the distance travelled by the particle before it returns to its initial position. [6]

6 Take g to be 10 m s^{-2} in this question.

Two blocks are connected by a light inextensible string. Block A has mass m_1 kg and is held at rest on a smooth horizontal table. Block B has mass m_2 kg and is hanging vertically. The string passes over a smooth pulley fixed at the end of the table as shown in **Fig. 3** below.

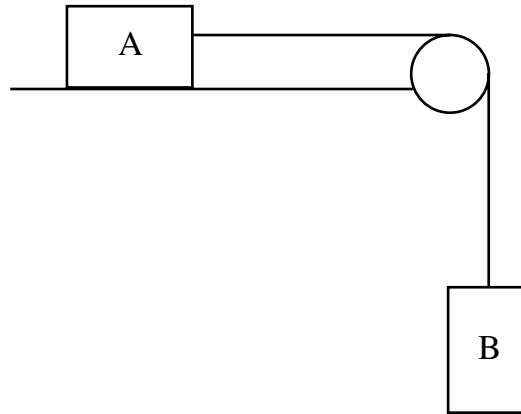


Fig. 3

When A is released from rest, the acceleration of B downwards is 2 m s^{-2}

(i) Draw a diagram showing the external forces acting on A and B. [2]

(ii) Show that $\frac{m_1}{m_2} = 4$ [5]

7 In two successive seconds, a car travels through 20 m and 15 m respectively. The car is travelling with uniform deceleration.

(i) Find the speed of the car at the start of the two seconds and its deceleration. [8]

(ii) Find after what further time the car will come to rest. [4]

- 8 A uniform rod AB of weight 20 N and length 2 m is smoothly hinged at A to a vertical wall. The rod is kept in a horizontal position by a light inextensible string BC which is 4 m long. C is a point on the wall vertically above A as shown in **Fig. 4** below.

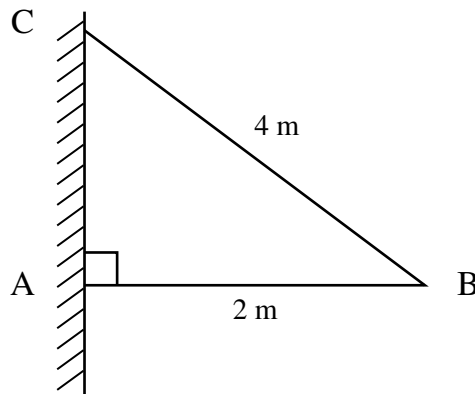


Fig. 4

- (i) Draw a diagram showing the external forces acting on the rod. [2]
- (ii) By taking moments about A , find the tension in the string. [5]
- (iii) Find the magnitude of the reaction at the wall. [6]
- (iv) If the string breaks when the tension in it is more than 150 N , find the greatest weight that can be hung from B . [4]

THIS IS THE END OF THE QUESTION PAPER
