Rewarding Learning

**ADVANCED SUBSIDIARY (AS)**
**General Certificate of Education**
**January 2010**

# Mathematics

Assessment Unit M1
*assessing*
Module M1: Mechanics 1

**[AMM11]**

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.

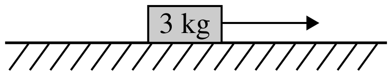


**Fig. 1**

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.

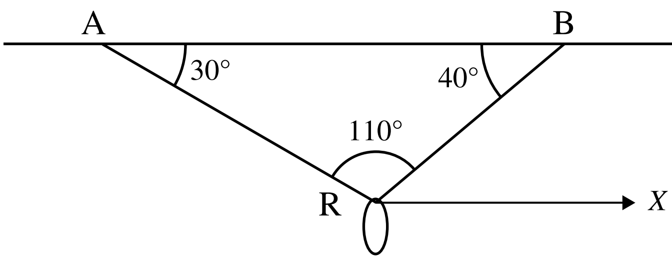


**Fig. 2**

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

$$B\hat{A}R = 30°$$
$$\text{and } A\hat{B}R = 40°$$

**(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 $\theta$ 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, $v$ 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 $10\,\mathrm{m\,s^{-2}}$ 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.

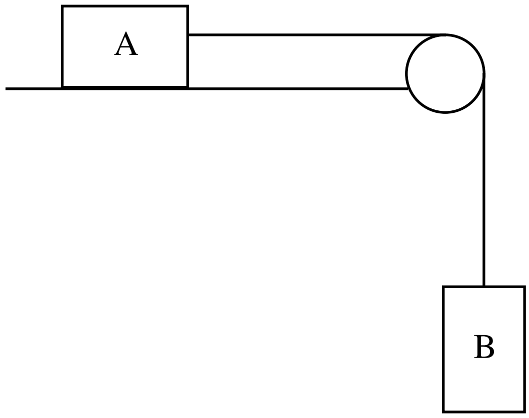


**Fig. 3**

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

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

**(ii)** Show that $\dfrac{m_1}{m_2} = 4$ [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.

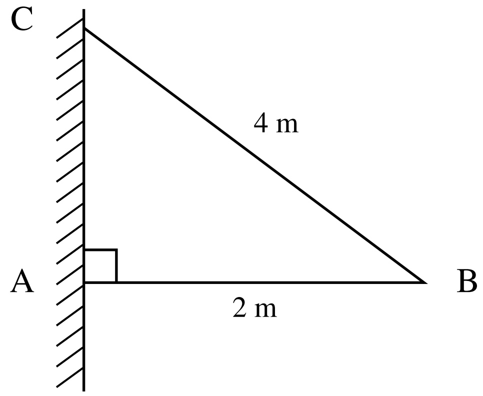


**Fig. 4**

**(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**