Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2009

Mathematics

Assessment Unit M1

assessing

Module M1: Mechanics 1

[AMM11]

AMM11

FRIDAY 15 MAY, MORNING

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 **Fig. 1** below shows a triangle ABC which is right angled at B.
Angle BCA is 50°
Forces of magnitudes 5 N, 8 N and 15 N, respectively, act along the sides AB, BC and CA of the triangle as shown.

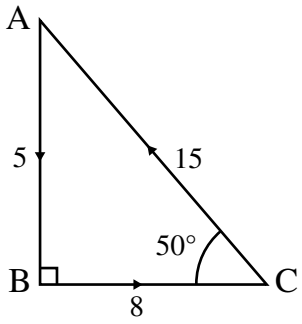

Fig. 1

Find the magnitude and direction of the resultant of these forces. [8]

2 A uniform rod AB of mass 80 kg and length 10 m rests in equilibrium on two supports P and Q as shown in **Fig. 2** below.
AP = 2 m, QB = 3 m.

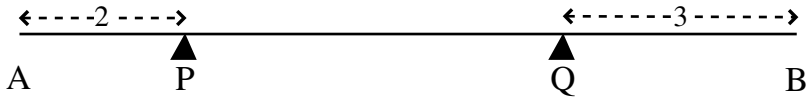

Fig. 2

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

(ii) Find the magnitudes of the reactions at P and Q. [6]

An additional mass of M kg is placed at B.

(iii) Find M if the rod is about to tilt. [4]

3 A stone is thrown vertically upwards from a point P with a speed of $14\,\text{m s}^{-1}$

(i) Find the maximum height reached by the stone. [4]

(ii) Find the length of time for which the stone is more than 8.4 m above P. [5]

4 A car of mass 800 kg pulls a trailer of mass 200 kg along a straight horizontal road, as shown in **Fig. 3** below.
The car and trailer have a constant acceleration of $2\,\text{m s}^{-2}$
The driving force produced by the car's engine is 2400 N.
The resistances acting on the car and trailer are 300 N and R newtons respectively.

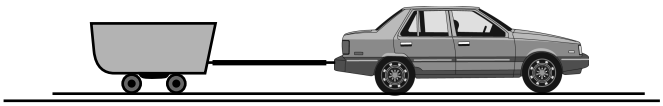

Fig. 3

(i) Draw a diagram showing all the external forces acting on the car and trailer. [2]

(ii) Find R, and the tension in the towbar between the car and the trailer. [7]

5 A particle, A, of mass 0.4 kg is travelling along a smooth horizontal table with a speed of $u\,\text{m s}^{-1}$
It collides directly with another particle, B, of mass 0.6 kg which is at rest.
Following the collision, A is at rest.

(i) Find, in terms of u, the speed of B immediately after the collision. [4]

(ii) Find, in terms of u, the impulse given by B to A. [3]

6 **Fig. 4** below shows a block of mass 10 kg being pulled up a rough plane inclined at 30° to the horizontal by a force of 100 N, acting parallel to the plane.
The coefficient of friction between the block and the plane is 0.3

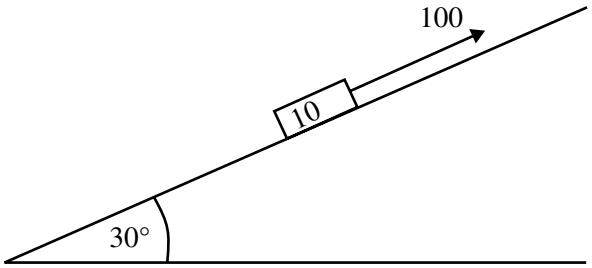

Fig. 4

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

(ii) Find the acceleration of the block. [6]

7 At time t seconds, $t \geqslant 0$, the velocity $v\,\mathrm{m\,s^{-1}}$ of a particle P moving in a straight line is given by

$$v = t^2 - 5t + 6$$

(i) Find the times when the particle is instantaneously at rest. [3]

(ii) Find an expression for the acceleration of P at time t. [2]

(iii) Given that, at $t = 6$, P is moving through a fixed point O, find an expression for s, the displacement of P from O, at time t. [4]

(iv) Hence find the distance travelled by P in the first 3 seconds of its motion. [4]

8 A motorcyclist is travelling along a straight horizontal motorway.
At time $t = 0$ seconds the motorcyclist, who is travelling at a speed of $30\,\mathrm{m\,s^{-1}}$ and accelerating at $0.2\,\mathrm{m\,s^{-2}}$, passes a police car which is at rest.
5 seconds later the police car sets off in pursuit of the motorcyclist, accelerating at $1\,\mathrm{m\,s^{-2}}$
Find the time taken for the police car to draw level with the motorcyclist. [9]