Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2011

Mathematics

Assessment Unit M1

assessing

Module M1: Mechanics 1

[AMM11]

AMM11

WEDNESDAY 18 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 $g = 9.8\,\text{m}\,\text{s}^{-2}$, 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 particle rests in equilibrium under the action of three forces as shown in **Fig. 1** below.

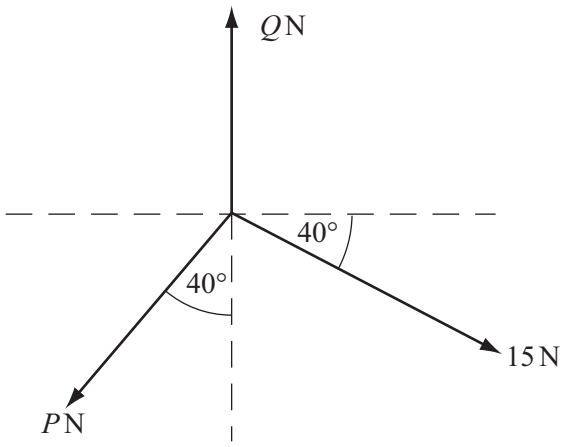

Fig. 1

Find P and Q. [6]

2 A stone is dropped from a bridge into a river below.
It takes 3 seconds for the stone to hit the water.

(i) Find how far the stone has fallen when it hits the water. [3]

(ii) Find the speed with which the stone hits the water. [3]

3 A man of mass 65 kg is travelling in a lift of mass 750 kg.

(i) Draw a diagram or diagrams showing all the external forces acting on the man and the lift. [2]

(ii) Find the tension in the cable when the lift is accelerating **upwards** at $0.2\,\text{m s}^{-2}$ [4]

(iii) Find the reaction between the floor of the lift and the man when the lift is accelerating **downwards** at $0.18\,\text{m s}^{-2}$ [4]

4 A ball, P, of mass $2m$ kilograms is travelling in a straight horizontal line with speed $2.2\,\text{m s}^{-1}$
It strikes a ball, Q, of mass m kilograms which is at rest.
After the collision P continues to move in its original direction with speed $1.2\,\text{m s}^{-1}$
Q moves in the same direction as P with speed $u\,\text{m s}^{-1}$

(i) Find u. [5]

(ii) Find in terms of m the impulse exerted by P on Q. [3]

(iii) State **one** modelling assumption you have made in answering this question. [1]

5 **Take $g = 10\,\text{m s}^{-2}$ in this question.**

A broom consists of a uniform pole, AB, with a broom head attached to end B.
The pole has mass 0.3 kg and length 1.2 m.
The broom head has mass 0.2 kg.
Lucy carries the broom by resting the pole on her shoulder at a point C and exerting a downward vertical force at A as shown in **Fig. 2** below.

Fig. 2

AC = 0.3 m
Model the shoulder as a pivot and the broom head as a particle.

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

(ii) Find the vertical forces exerted at A and C. [7]

6 A crate of mass 30 kg rests in equilibrium on a rough plane inclined at 60º to the horizontal. The coefficient of friction between the crate and the plane is $\frac{1}{3}$
When a horizontal force, P N, is applied to the crate it is on the point of moving up the plane, as shown in **Fig. 3** below.

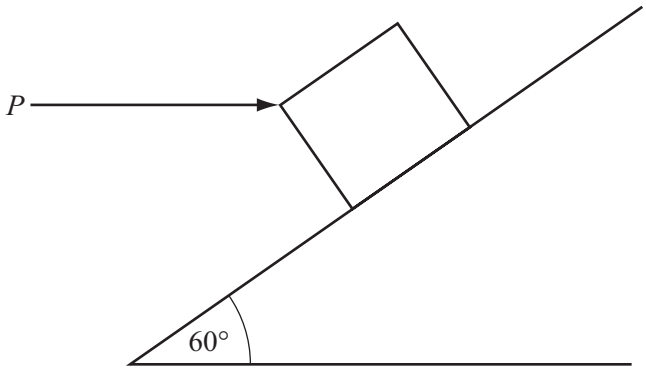

Fig. 3

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

(ii) Find P. [8]

7 At time t seconds, $t \geqslant 0$, the acceleration a m s^{-2} of a particle, P, is given by

$$a = 6t + 3$$

At $t = 0$, P passes through a fixed origin, O, with velocity -18 m s^{-1}

(i) Find an expression for the velocity of P at any time t. [4]

(ii) Show that P changes its direction of motion only once. [4]

(iii) Find an expression for the displacement of P from O at any time t. [3]

(iv) Find the total distance travelled by P between $t = 0$ and $t = 4$ [4]

8 Towards the end of a cycle race Daniel is x metres from the finish line and is cycling at a constant speed of $12\,\text{m}\,\text{s}^{-1}$
John is 20 m behind Daniel and is cycling at $10\,\text{m}\,\text{s}^{-1}$
John decides to accelerate to try to beat Daniel.
John accelerates uniformly at $2\,\text{m}\,\text{s}^{-2}$
Daniel finishes the race in T seconds and beats John who finishes 1s later.

Find T and x. [10]

THIS IS THE END OF THE QUESTION PAPER