



Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2011

Mathematics

Assessment Unit M1
assessing
Module M1: Mechanics 1
[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 $g = 9.8 \text{ m s}^{-2}$, 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.

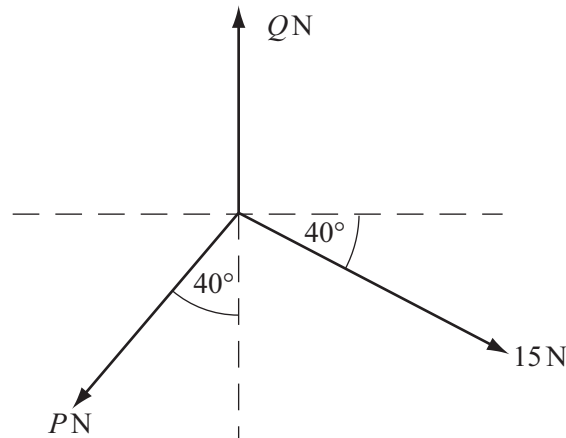


Fig. 1

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 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 m s^{-2}

[4]

- 4 A ball, P, of mass $2m$ kilograms is travelling in a straight horizontal line with speed 2.2 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 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

$AC = 0.3 \text{ m}$

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 60° 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.

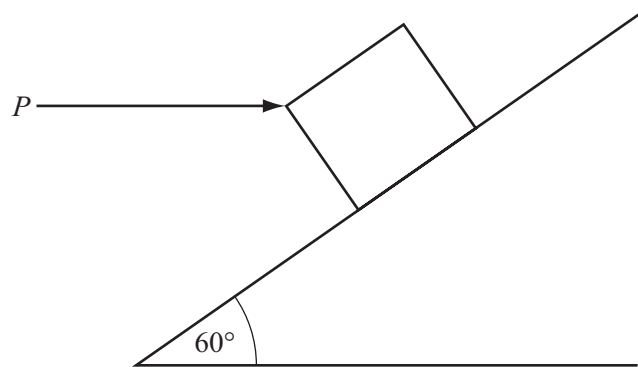


Fig. 3

- (i) Draw a diagram showing all the external forces acting on the crate. [2]
- (ii) Find P . [8]
- 7 At time t seconds, $t \geq 0$, the acceleration $a \text{ m s}^{-2}$ 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 m s^{-1}
John is 20 m behind Daniel and is cycling at 10 m s^{-1}
John decides to accelerate to try to beat Daniel.
John accelerates uniformly at 2 m s^{-2}
Daniel finishes the race in T seconds and beats John who finishes 1 s later.

Find T and x .

[10]

THIS IS THE END OF THE QUESTION PAPER
