Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
January 2009

Mathematics

Assessment Unit M1

assessing

Module M1: Mechanics 1

[AMM11]

AMM11

TUESDAY 13 JANUARY, 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 $g = 9.8\,\mathrm{m\,s^{-2}}$, 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 Four forces 5 N, 8 N, P N and Q N are in equilibrium and act at a point as shown in **Fig. 1** below.
The 5 N and P N forces are perpendicular.

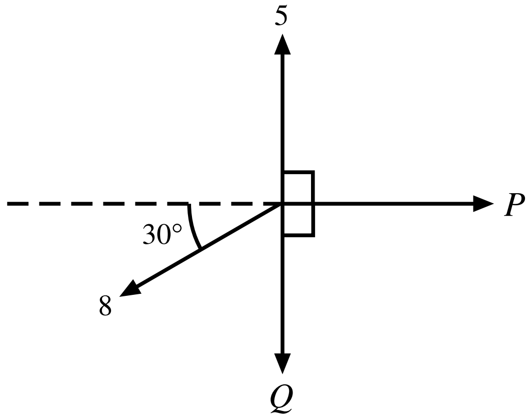

Fig. 1

Find P and Q. [6]

2 A van is travelling along a straight horizontal road with an acceleration of $0.5\,\text{m}\,\text{s}^{-2}$
When the van passes a point A its velocity is $10\,\text{m}\,\text{s}^{-1}$
It reaches a point B 1 minute later.

(i) Find the distance AB. [3]

The van's mass is 1000 kg and its engine exerts a force of 5500 N.

(ii) Find the resistance to the van's motion. [4]

3 A ball of mass 0.2 kg falls vertically and strikes horizontal ground with a speed of $8\,\text{m s}^{-1}$
The ball rebounds vertically with a speed of $6\,\text{m s}^{-1}$

(i) Find the impulse exerted on the ball by the ground during the impact. [4]

(ii) If the impact lasted for 0.01 s, find the magnitude of the average force exerted by the ground on the ball. [2]

4 **Fig. 2** below shows a box of mass m kg resting in equilibrium on a rough plane inclined at $\theta°$ to the horizontal, where $\sin\theta = \frac{3}{5}$

The coefficient of friction between the box and the plane is μ.

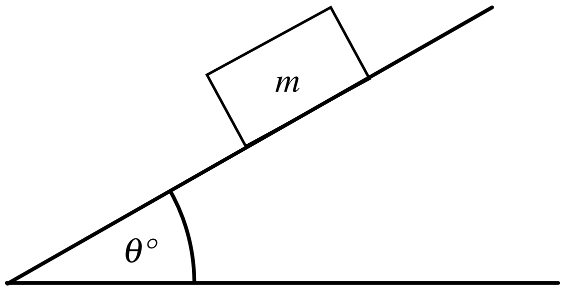

Fig. 2

The box is on the point of slipping down the plane.

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

(ii) Find μ. [6]

5 A particle P moves along a straight horizontal line passing through a fixed point O at time $t = 0$ seconds.
At time t its displacement s metres, from O, is given by

$$s = t^3 - 6t^2 + 9t$$

(i) Find the velocity of P in terms of t. [2]

(ii) Find the acceleration of P in terms of t. [2]

(iii) Hence find the time when P attains its minimum velocity. [3]

6 A car has an initial velocity of $20\,\mathrm{m\,s^{-1}}$
For the first 4 seconds of its motion it accelerates at $2.5\,\mathrm{m\,s^{-2}}$
For the next T seconds it travels at a constant velocity of $V\,\mathrm{m\,s^{-1}}$
The car then decelerates to rest.

(i) Sketch a velocity–time graph for the whole journey of the car. [3]

(ii) Find V. [2]

The total time for the journey is 40 seconds.

(iii) If the total distance travelled by the car is 1090 m, find T. [7]

7 A uniform ladder AB, of length 6 m and mass 30 kg, rests with its end A against a smooth vertical wall.
Its end B rests on rough horizontal ground as shown in **Fig. 3** below.
The ladder makes an angle of 60° with the horizontal.
The coefficient of friction between the ladder and the ground is 0.5

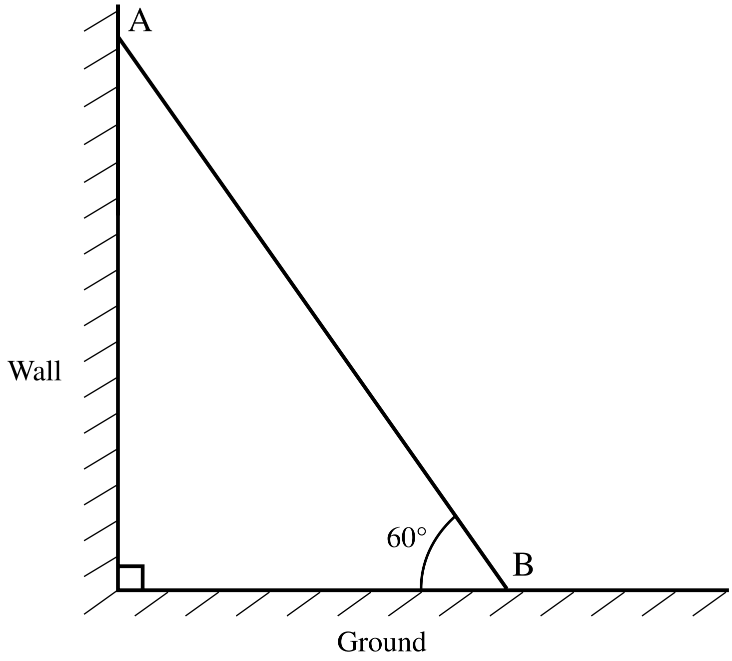

Fig. 3

A man of mass 100 kg ascends the ladder.

(i) Draw a diagram which shows all the external forces acting on the ladder. [2]

(ii) Find how far up the ladder, from B, the man can ascend before the ladder begins to slip. [10]

8 A light inextensible string passes over a smooth fixed pulley as shown in **Fig. 4** below.
A block of mass 6 kg is attached to one end of the string and a block of mass 4 kg is attached to the other end.

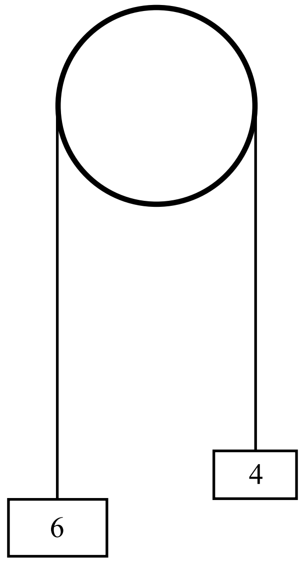

Fig. 4

When $t = 0$ s the system is released from rest with the 6 kg mass 2 m above ground level.

(i) Find the acceleration of the system. [5]

The 4 kg mass does not strike the pulley in any subsequent motion.

(ii) Find the velocity with which the 6 kg mass hits the ground. [2]

(iii) Find the value of t when the 6 kg mass hits the ground. [3]

(iv) Find the value of t when the string becomes taut again. [7]

THIS IS THE END OF THE QUESTION PAPER