Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2010

Mathematics

Assessment Unit M1

assessing

Module M1: Mechanics 1

[AMM11]

AMM11

TUESDAY 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 The three forces shown in **Fig. 1** below are in equilibrium.

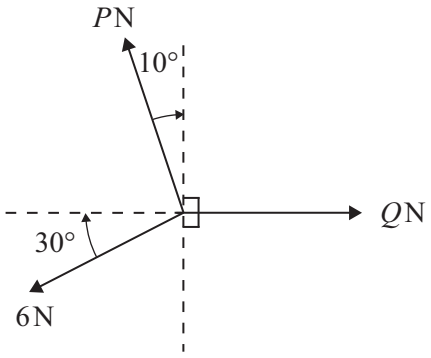

Fig. 1

Find P and Q. [7]

2 A car travelling at $10\,m\,s^{-1}$ accelerates uniformly at $5\,m\,s^{-2}$ until it reaches a speed of $30\,m\,s^{-1}$
It travels at this speed for 5 s.
The car then decelerates for 10 s until it stops.

(i) Draw a velocity/time graph to show the motion of the car. [2]

(ii) Find the time taken for the car to accelerate from $10\,m\,s^{-1}$ to $30\,m\,s^{-1}$ [2]

(iii) Find the total distance travelled by the car. [4]

3 A bullet of mass 0.05 kg is travelling horizontally at 450 m s^{-1} when it hits a vertical wooden target.
The speed of the bullet is reduced to 200 m s^{-1}, 0.002 s after the bullet hits the target.

(i) Find the change in the momentum of the bullet. [2]

(ii) Find the resistive force exerted by the target on the bullet. [2]

4 At time $t = 0$ seconds, a parcel P of mass 4 kg is at rest on a smooth horizontal table.
Two horizontal forces of magnitude 6 N and 10 N act on P.
The angle between the two forces is 60° as shown in **Fig. 2** below.

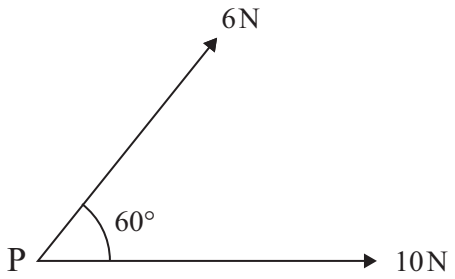

Fig. 2

(i) Show that the magnitude of the resultant force acting on P is 14 N. [3]

(ii) Find the magnitude of the parcel's acceleration. [2]

(iii) Find the distance travelled by P in the first 3 s of its motion. [2]

5 A **non-uniform** plank PQ has mass 90 kg and length 6 m.
It rests on two smooth supports at P and Q. A man of mass 72 kg stands at a point S on the plank, where S is 2 m from Q as shown in **Fig. 3** below.

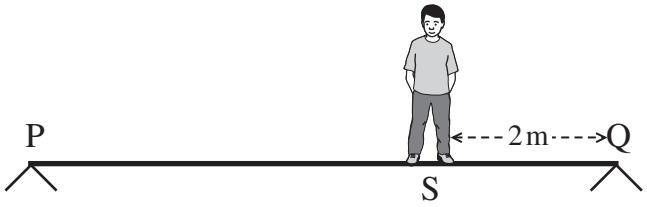

Fig. 3

The plank is horizontal and in equilibrium. The reaction at Q is twice the reaction at P.

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

(ii) Find the magnitudes of the reactions at P and Q. [4]

(iii) Find the distance of the centre of mass of the plank from P. [5]

6 At time t seconds the acceleration, $a\,\text{m s}^{-2}$, of a particle, P, moving in a straight line is given by

$$a = 4t - 10t^3$$

When $t = 0$, P has velocity $\frac{5}{2}\,\text{m s}^{-1}$ and is at a fixed point O.

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

(ii) Find the displacement of P from O at any time t. [3]

(iii) Find the exact time at which P returns to O. [4]

7 Three smooth spheres A, B and C of equal radius lie at rest, in a straight line, on a smooth horizontal table as shown in **Fig. 4** below.

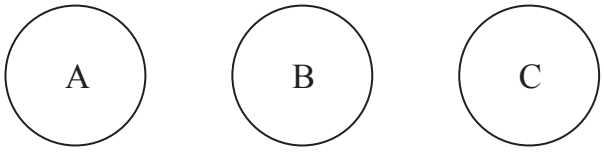

Fig. 4

A has mass m.
B has mass $2m$.
C has mass $3m$.

A is projected towards B with speed u.
A is brought to rest by the collision.

(i) Find the speed of B after the collision. [4]

B then collides with C.
The speed of C after the collision is $\frac{2u}{3}$

(ii) Show that B will collide again with A. [4]

A and B coalesce after their second collision.

(iii) Find their final speed and direction. [3]

8 Two boxes, P and Q, are connected by a light inextensible rope which passes over a smooth fixed pulley at B.

P, mass 3 kg, rests on the rough plane AB.
AB is inclined at 40° to the horizontal.
The coefficient of friction between P and the plane is 0.3

Q, mass 5 kg, rests on the rough plane CB.
CB is inclined at 60° to the horizontal.
The coefficient of friction between Q and the plane is 0.1

AB and BC lie in the same vertical plane as shown in **Fig. 5** below.

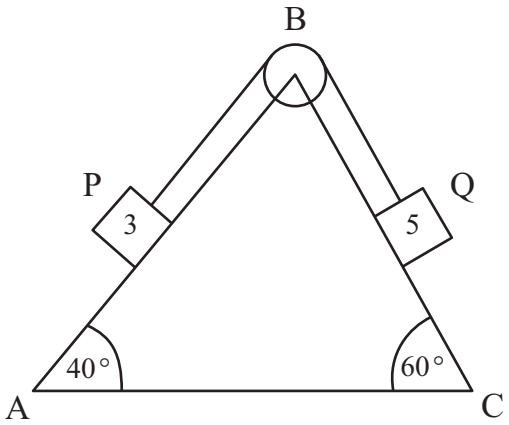

Fig. 5

The boxes are released from rest.
Q slides down BC.

(i) Draw a diagram showing the external forces acting on P and Q. [3]

(ii) Find the tension in the rope and the acceleration of P. [13]

THIS IS THE END OF THE QUESTION PAPER