



Rewarding Learning

ADVANCED SUBSIDIARY (AS)  
General Certificate of Education  
2010

---

## Mathematics

Assessment Unit M1

*assessing*

Module M1: Mechanics 1

[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.

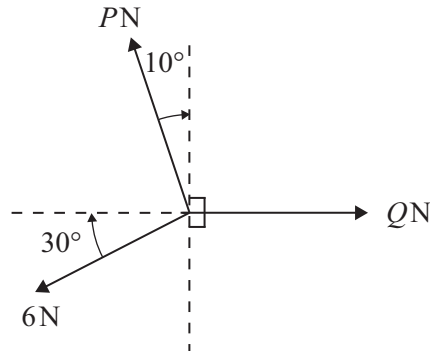
A copy of the **Mathematical Formulae and Tables booklet** is provided.

**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  $10 \text{ m s}^{-1}$  accelerates uniformly at  $5 \text{ m s}^{-2}$  until it reaches a speed of  $30 \text{ m s}^{-1}$   
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  $10 \text{ m s}^{-1}$  to  $30 \text{ m s}^{-1}$

[2]

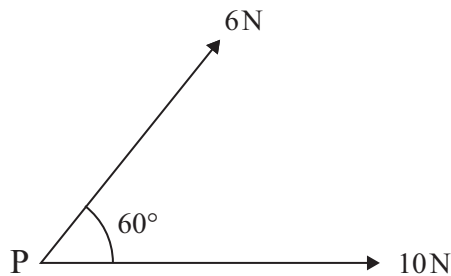
(iii) Find the total distance travelled by the car.

[4]

- 3 A bullet of mass  $0.05 \text{ kg}$  is travelling horizontally at  $450 \text{ m s}^{-1}$  when it hits a vertical wooden target.  
The speed of the bullet is reduced to  $200 \text{ m s}^{-1}$ ,  $0.002 \text{ s}$  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  $4 \text{ kg}$  is at rest on a smooth horizontal table.  
Two horizontal forces of magnitude  $6 \text{ N}$  and  $10 \text{ N}$  act on P.  
The angle between the two forces is  $60^\circ$  as shown in **Fig. 2** below.



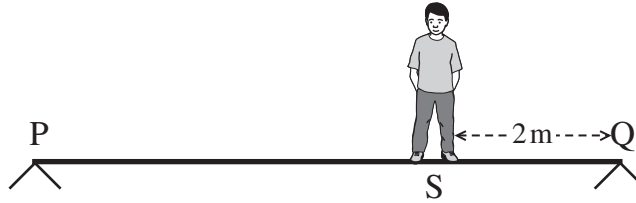
**Fig. 2**

- (i) Show that the magnitude of the resultant force acting on P is  $14 \text{ N}$ . [3]

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

- (iii) Find the distance travelled by P in the first  $3 \text{ s}$  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]

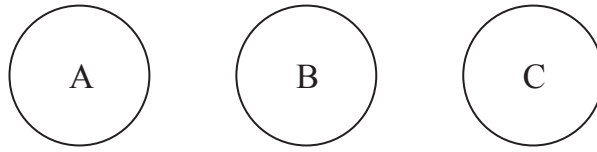
- 6 At time  $t$  seconds the acceleration,  $a \text{ m s}^{-2}$ , of a particle, P, moving in a straight line is given by

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

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  $40^\circ$  to the horizontal.

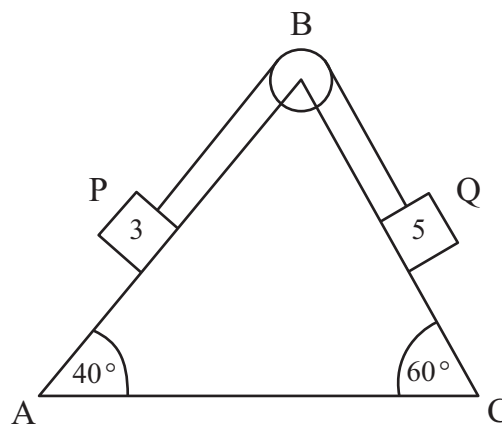
The coefficient of friction between P and the plane is 0.3

Q, mass 5 kg, rests on the rough plane CB.

CB is inclined at  $60^\circ$  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**

---



