



Rewarding Learning

ADVANCED SUBSIDIARY (AS)  
General Certificate of Education  
2009

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## Mathematics

Assessment Unit M1

*assessing*

Module M1: Mechanics 1

[AMM11]



FRIDAY 15 MAY, MORNING

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### 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 **Fig. 1** below shows a triangle ABC which is right angled at B. Angle BCA is  $50^\circ$ . Forces of magnitudes 5 N, 8 N and 15 N, respectively, act along the sides AB, BC and CA of the triangle as shown.

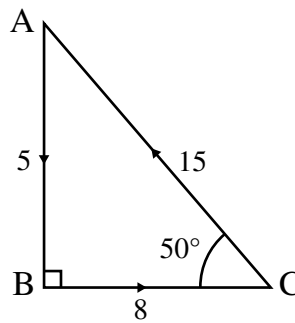


Fig. 1

Find the magnitude and direction of the resultant of these forces. [8]

- 2 A uniform rod AB of mass 80 kg and length 10 m rests in equilibrium on two supports P and Q as shown in **Fig. 2** below. AP = 2 m, QB = 3 m.

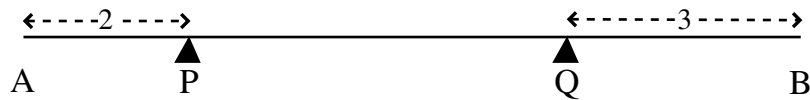


Fig. 2

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

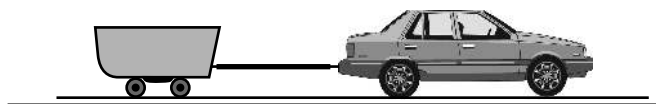
(ii) Find the magnitudes of the reactions at P and Q. [6]

An additional mass of  $M$  kg is placed at B.

(iii) Find  $M$  if the rod is about to tilt. [4]

- 3 A stone is thrown vertically upwards from a point P with a speed of  $14 \text{ m s}^{-1}$
- (i) Find the maximum height reached by the stone. [4]
- (ii) Find the length of time for which the stone is more than 8.4 m above P. [5]

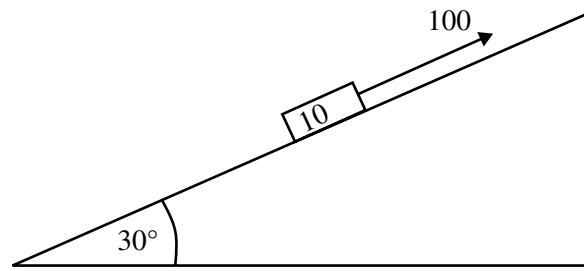
- 4 A car of mass 800 kg pulls a trailer of mass 200 kg along a straight horizontal road, as shown in **Fig. 3** below.
- The car and trailer have a constant acceleration of  $2 \text{ m s}^{-2}$
- The driving force produced by the car's engine is 2400 N.
- The resistances acting on the car and trailer are 300 N and  $R$  newtons respectively.



**Fig. 3**

- (i) Draw a diagram showing all the external forces acting on the car and trailer. [2]
- (ii) Find  $R$ , and the tension in the towbar between the car and the trailer. [7]
- 5 A particle, A, of mass 0.4 kg is travelling along a smooth horizontal table with a speed of  $u \text{ m s}^{-1}$
- It collides directly with another particle, B, of mass 0.6 kg which is at rest.
- Following the collision, A is at rest.
- (i) Find, in terms of  $u$ , the speed of B immediately after the collision. [4]
- (ii) Find, in terms of  $u$ , the impulse given by B to A. [3]

- 6 **Fig. 4** below shows a block of mass 10 kg being pulled up a rough plane inclined at  $30^\circ$  to the horizontal by a force of 100 N, acting parallel to the plane.  
The coefficient of friction between the block and the plane is 0.3



**Fig. 4**

- (i) Draw a diagram showing all the external forces acting on the block. [2]
- (ii) Find the acceleration of the block. [6]
- 7 At time  $t$  seconds,  $t \geq 0$ , the velocity  $v \text{ m s}^{-1}$  of a particle P moving in a straight line is given by
- $$v = t^2 - 5t + 6$$
- (i) Find the times when the particle is instantaneously at rest. [3]
- (ii) Find an expression for the acceleration of P at time  $t$ . [2]
- (iii) Given that, at  $t = 6$ , P is moving through a fixed point O, find an expression for  $s$ , the displacement of P from O, at time  $t$ . [4]
- (iv) Hence find the distance travelled by P in the first 3 seconds of its motion. [4]
- 8 A motorcyclist is travelling along a straight horizontal motorway.  
At time  $t = 0$  seconds the motorcyclist, who is travelling at a speed of  $30 \text{ m s}^{-1}$  and accelerating at  $0.2 \text{ m s}^{-2}$ , passes a police car which is at rest.  
5 seconds later the police car sets off in pursuit of the motorcyclist, accelerating at  $1 \text{ m s}^{-2}$   
Find the time taken for the police car to draw level with the motorcyclist. [9]