



Rewarding Learning

ADVANCED SUBSIDIARY (AS)  
General Certificate of Education  
2012

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## Mathematics

Assessment Unit M1

*assessing*

Module M1: Mechanics 1

[AMM11]



WEDNESDAY 16 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 seven** 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 a 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.



7125.03R

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Answer all seven questions.

Show clearly the full development of your answers.

Answers should be given to three significant figures unless otherwise stated.

- 1 The four forces shown in Fig. 1 below are in equilibrium.

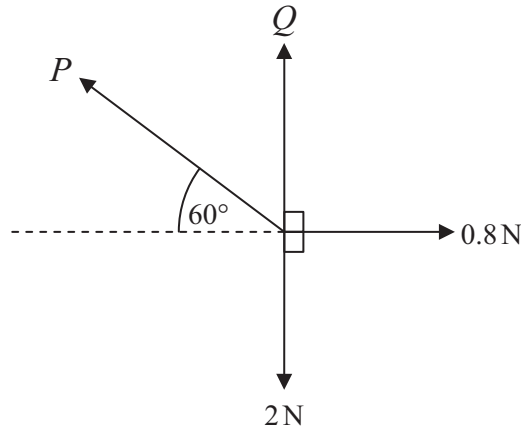


Fig. 1

Find  $P$  and  $Q$ .

[6]

- 2 Fig. 2 below shows a car of mass  $1300\text{ kg}$  ascending a hill inclined at an angle of  $20^\circ$  to the horizontal.

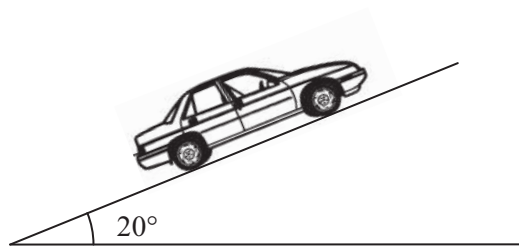


Fig. 2

The coefficient of friction between the car and the hill is  $0.25$   
The tractive force produced by the engine of the car is  $12\,000\text{ N}$ .

- (i) Draw a diagram showing all the external forces acting on the car.

[2]

- (ii) Find the acceleration of the car.

[7]

3 In a shooting competition an Olympic competitor fires a bullet from a rifle with a speed of  $330 \text{ m s}^{-1}$

The mass of the gun is 6 kg and the mass of the bullet is 0.2 kg.

(i) Find the **speed** of recoil of the gun on the competitor's shoulder. [5]

The gun comes to rest after 0.1 s.

(ii) Find the average force exerted by the gun on the competitor's shoulder during this time. [5]

4 At time  $t = 0$  seconds, a stone A is thrown vertically upwards from ground level, with speed  $u \text{ m s}^{-1}$

The greatest height above the ground reached by A is 2.5 m.

(i) Find  $u$ . [3]

When  $t = 1$ , a stone B is thrown vertically upwards from ground level, with speed  $5 \text{ m s}^{-1}$

(ii) Find  $t$  when A and B collide. [6]

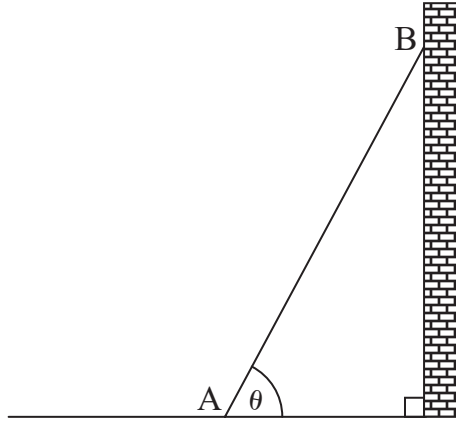
- 5 At time  $t$  seconds,  $t \geq 0$ , the acceleration  $a \text{ ms}^{-2}$  of a particle P, which is moving in a straight line, is given by

$$a = 2t - 10$$

At time  $t = 0$ , P has velocity  $21 \text{ ms}^{-1}$  and is at the fixed point O.

- (i) Find an expression for the velocity of P at any time  $t$ . [4]
- (ii) Find the times at which P is instantaneously at rest. [3]
- (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  $t = 2$  and  $t = 6$  [4]

- 6 A uniform ladder of weight 150 N and length 4 m rests in equilibrium. The end A rests on rough horizontal ground and the end B rests against a smooth vertical wall, as shown in **Fig. 3** below. The coefficient of friction between the ground and the ladder is  $\mu$ . The ladder makes an angle of  $\theta$  with the horizontal, where  $\tan \theta = \frac{12}{5}$

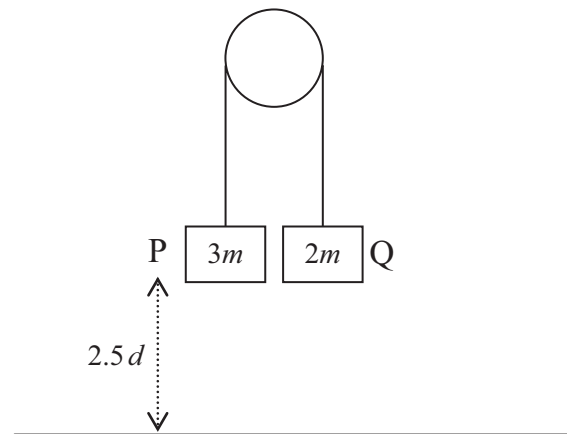


**Fig. 3**

When a man of weight 800 N stands on the ladder, 1 m from the end B, the ladder is about to slip.

- (i) Draw a diagram to show all the external forces acting on the ladder. [2]
- (ii) By taking moments about A, find the normal reaction at B. [5]
- (iii) Hence find  $\mu$ . [5]

- 7 A light inextensible string passes over a smooth fixed pulley as shown in **Fig. 4** below. Particles P and Q of masses  $3m$  kg and  $2m$  kg respectively are attached to each end.



**Fig. 4**

At time  $t = 0$  seconds, the system is released from rest, with the particle P at a height of  $2.5d$  metres above the horizontal floor.

- (i) Draw a diagram showing the forces acting on the particles P and Q. [2]

- (ii) Find, in terms of  $g$ , the acceleration of the particles. [5]

Given that Q does not reach the pulley, find, in terms of  $g$  and  $d$ :

- (iii) the speed with which P hits the floor; [2]

- (iv) the value of  $t$  at which the string becomes taut again. [6]

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**THIS IS THE END OF THE QUESTION PAPER**

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