



Rewarding Learning

ADVANCED SUBSIDIARY (AS)  
General Certificate of Education  
2013

---

## Mathematics

Assessment Unit M1

*assessing*

Module M1: Mechanics 1

[AMM11]



MONDAY 13 MAY, AFTERNOON

---

### 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 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.

**BLANK PAGE**

Answer all seven questions.

Show clearly the full development of your answers.

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

- 1 A particle rests in equilibrium under the action of three forces as shown in Fig. 1 below.

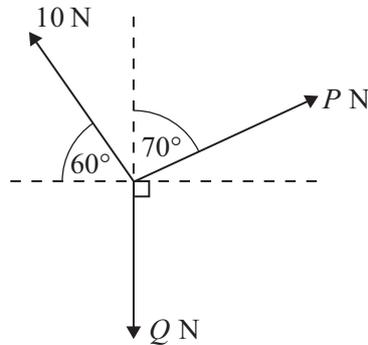


Fig. 1

Find  $P$  and  $Q$ .

[6]

- 2 At time  $t = 0$  seconds a ball is projected vertically upwards with speed  $u \text{ ms}^{-1}$  from a point  $O$ .  
When  $t = 3$  the ball returns to  $O$ .

(i) Find  $u$ .

[4]

(ii) Find the greatest height above  $O$  reached by the ball.

[4]

3 A lift has mass 800 kg.

- (i) Find the tension in the lift cable when the lift is accelerating **downwards** at  $0.9 \text{ m s}^{-2}$  without any passengers. [4]

The greatest tension the lift cable can support is 15 000 N.  
The average mass of a person travelling in the lift is 80 kg.

- (ii) Find the maximum number of passengers that the lift can safely carry when it is accelerating **upwards** at  $0.9 \text{ m s}^{-2}$  [6]

- (iii) Give two modelling assumptions that you have made in answering parts (i) and (ii). [2]

4 A particle, P, moves in a straight line such that its velocity,  $v \text{ m s}^{-1}$ , at time  $t$  seconds is given by

$$v = 2t^2 - 15t + 18$$

- (i) Find the times at which P is momentarily at rest. [3]

When  $t = 0$ , P is at a fixed origin O.

- (ii) Find an expression for the displacement of P from O at any time  $t$ . [4]

- (iii) Find the distance travelled by P in the interval  $1 \leq t \leq 6$  [5]

5 Two particles A and B are travelling directly towards each other on a smooth horizontal surface.

A has mass 2 kilograms and speed  $4 \text{ m s}^{-1}$

A and B collide.

In the collision the magnitude of the impulse exerted by B on A is 18Ns.

- (i) Find the velocity of A after the collision. [4]

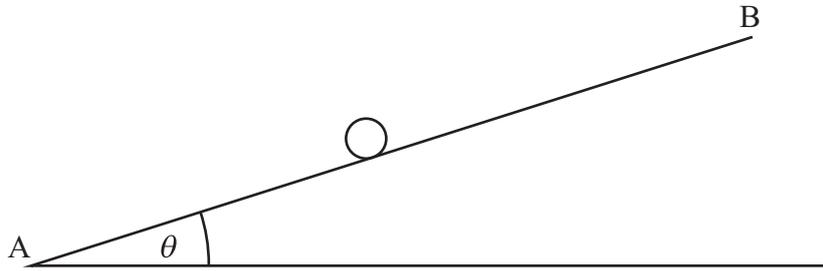
B has mass  $m$  kilograms and its speed before the collision is  $3 \text{ m s}^{-1}$

After the collision the speed of B is  $1.5 \text{ m s}^{-1}$

- (ii) Find the two possible values of  $m$ . [5]

6 Take  $g = 10 \text{ m s}^{-2}$  in this question.

**Fig. 2** below shows a particle of mass  $M$  kilograms moving up the line of greatest slope of a rough plane AB.



**Fig. 2**

The plane is inclined at an angle  $\theta$  to the horizontal where  $\sin \theta = \frac{3}{5}$   
The coefficient of friction between the particle and the plane is  $\mu$ .

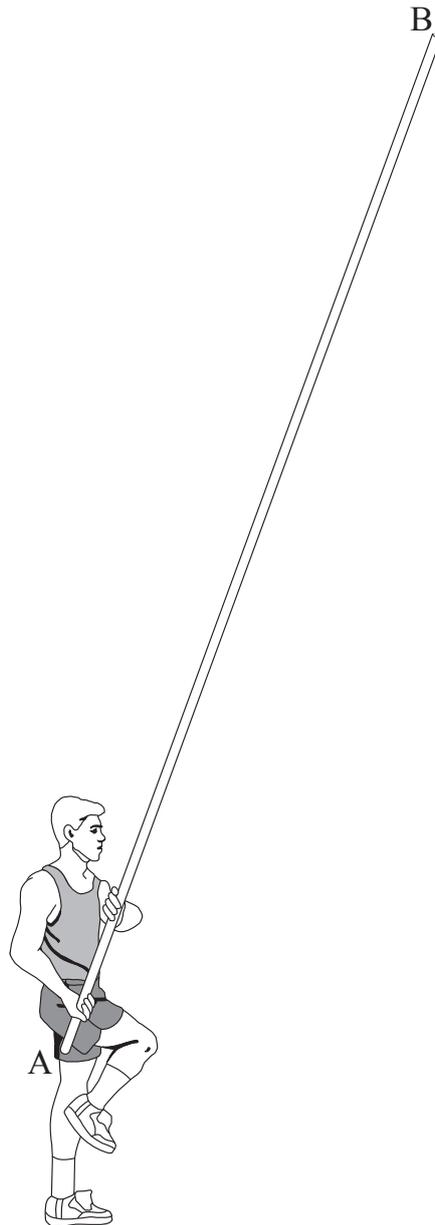
(i) Draw a diagram which shows all the forces acting on the particle. [2]

At A the particle has a velocity of  $U \text{ m s}^{-1}$   
 $T$  seconds later the particle comes to rest at B.

(ii) Find, in terms of  $\mu$ , the acceleration of the particle up the plane. [8]

(iii) Show that  $U = (6 + 8\mu)T$  [3]

- 7 **Fig. 3** below shows a pole vaulter Tom, at rest, holding a pole AB of length 5 m and mass 4 kg.



**Fig. 3**

**Fig. 4** opposite shows this pole held at  $70^\circ$  to the horizontal.

Tom's hands are placed at two points C and D on the pole where  $AC = 0.2$  m and  $CD = 0.5$  m.

Tom exerts a force  $P$  newtons, at right angles to the pole, at C and a force  $Q$  newtons at D.

Model the pole as a uniform rod.

- (i) Draw a diagram showing all the external forces acting on the pole. [2]
- (ii) By taking moments about D, find  $P$ . [5]
- (iii) Find the magnitude of  $Q$  and the angle it makes with the pole. [8]

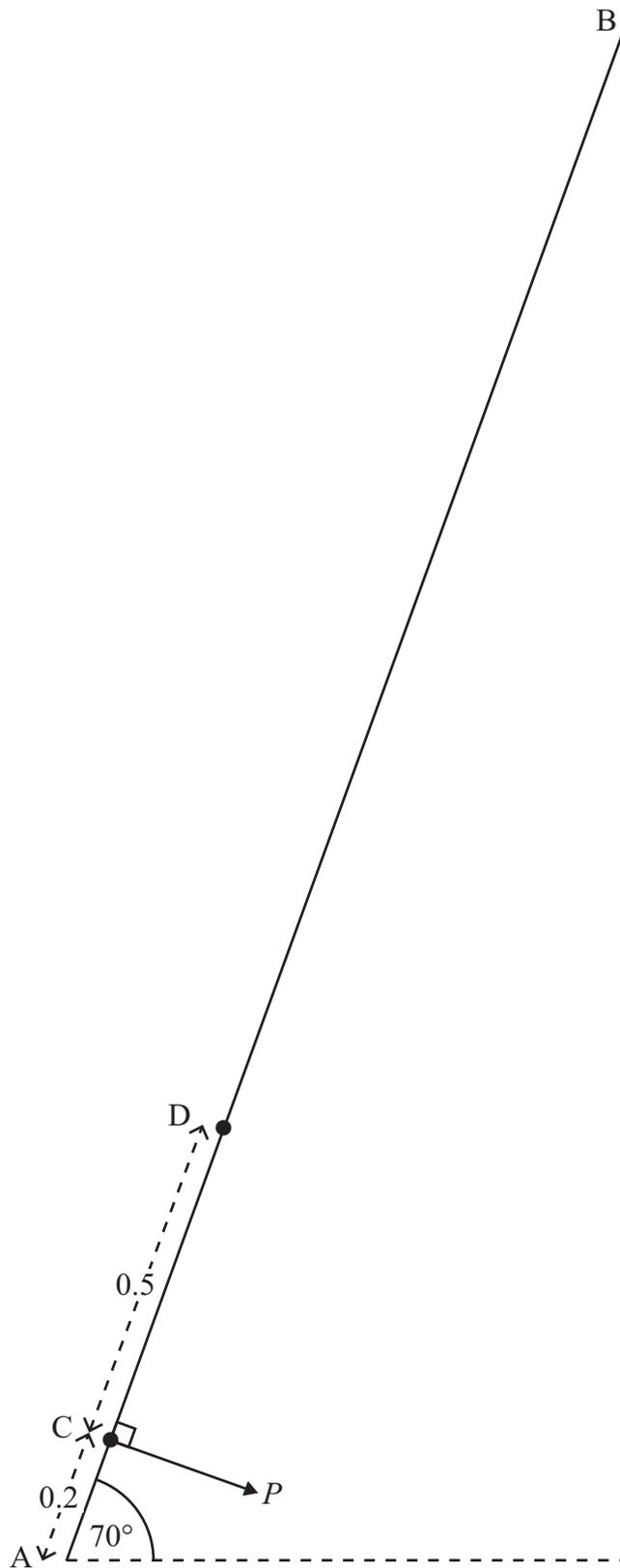


Fig. 4

---

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

---

