Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2013

Mathematics

Assessment Unit M1

assessing

Module M1: Mechanics 1

[AMM11]

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.

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

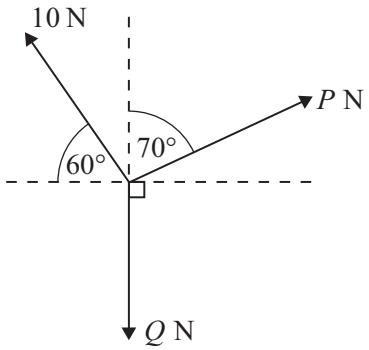

Fig. 1

Find P and Q. [6]

2 At time $t = 0$ seconds a ball is projected vertically upwards with speed u m s^{-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 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 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 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 $1 \leqslant t \leqslant 6$ [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 m s^{-1}
A and B collide.
In the collision the magnitude of the impulse exerted by B on A is 18 Ns.

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

B has mass m kilograms and its speed before the collision is 3 m s^{-1}
After the collision the speed of B is 1.5 m s^{-1}

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

6 Take g = 10 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.

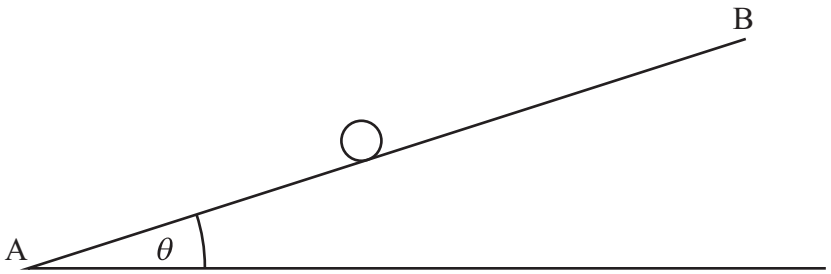

Fig. 2

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

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

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

(ii) Find, in terms of μ, 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.

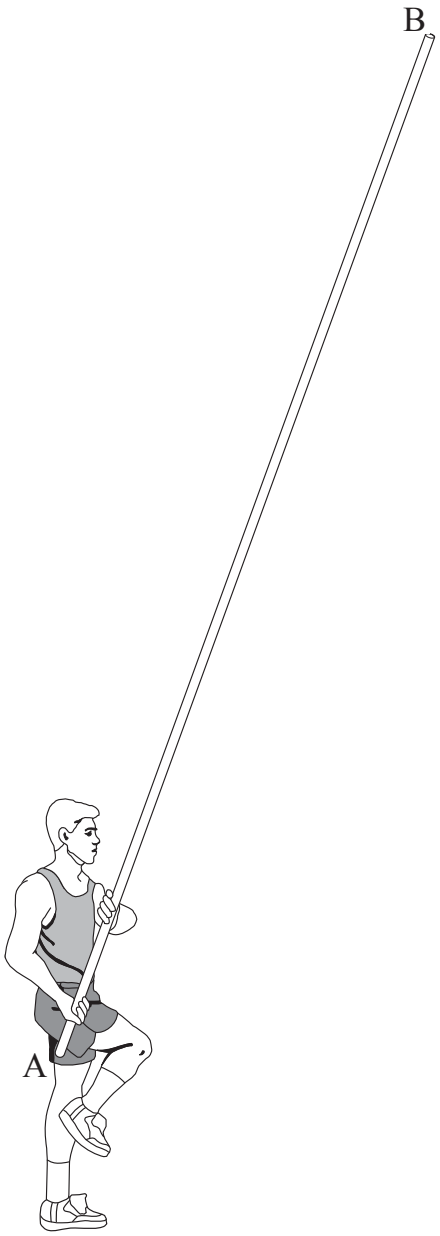

Fig. 3

Fig. 4 opposite shows this pole held at 70° 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]

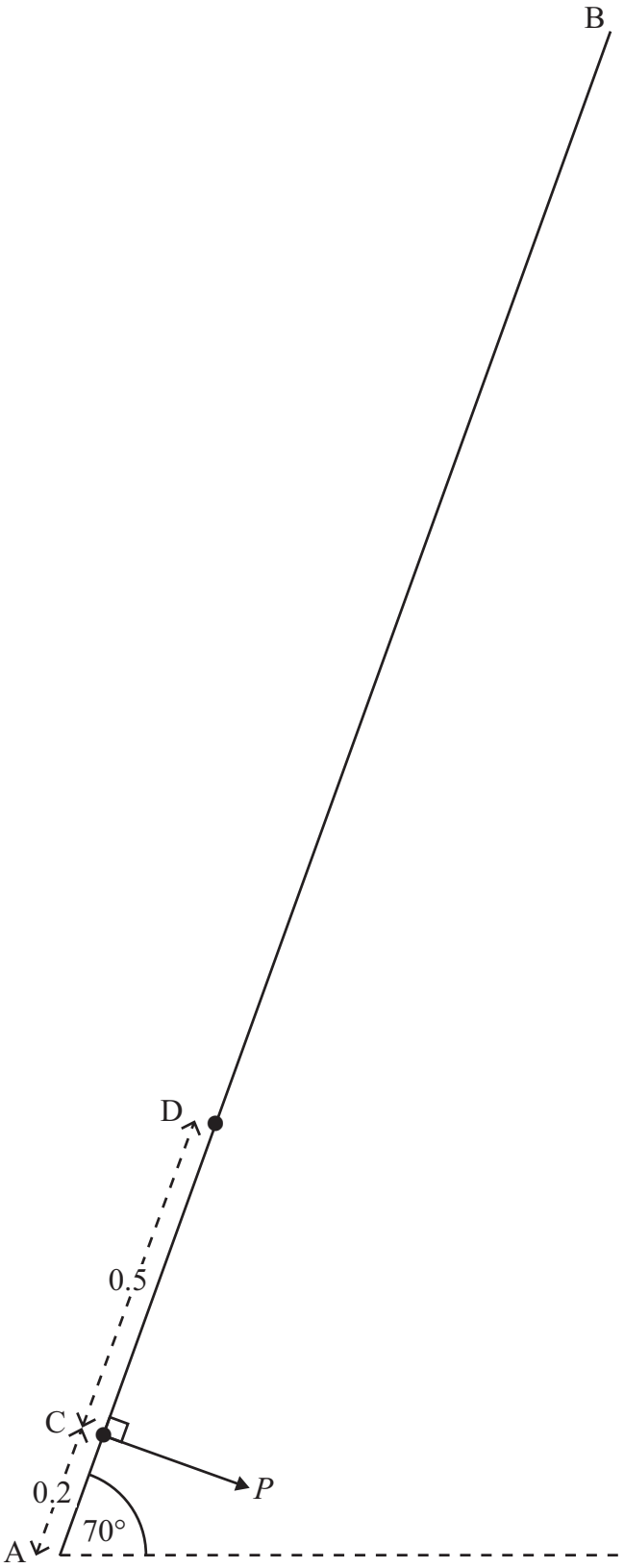

Fig. 4

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