



Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2015

Mathematics

Assessment Unit M1

assessing

Module M1: Mechanics 1



[AMM11]

THURSDAY 14 MAY, MORNING

TIME

1 hour 30 minutes, plus your additional time allowance.

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** Two particles A and B are travelling in the same direction along the same line on a smooth horizontal surface. This is shown in **Fig. 1** below.



Fig. 1

Particle A has mass 6 kg and is travelling at 5 m s^{-1}
Particle B has mass 4 kg and is travelling at 2 m s^{-1}

The two particles collide and coalesce.

- (i) Find the speed of the combined particle after the collision. [4]
- (ii) Find the magnitude of the impulse given to B as a result of the collision. [2]
- 2** A stone is thrown vertically upwards from ground level with a speed of 20 m s^{-1}
- (i) Find the maximum height above the ground reached by the stone. [3]
- (ii) Find the time taken for the stone to reach this maximum height. [2]
- (iii) Find the distance travelled by the stone during the first three seconds of its motion. [4]

- 3 A particle P, of mass 10 kg, hangs from a string. This string is light and inextensible. The other end of the string is fixed. Particle P is held against a smooth vertical wall by a force of magnitude 40 N acting at 30° to the horizontal. This is shown in **Fig. 2** below. The string makes an angle of 5° with the wall.

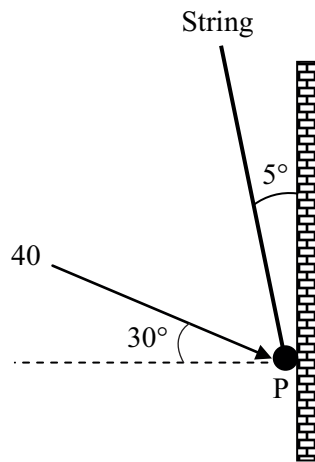


Fig. 2

P is in equilibrium.

- (i) Draw a diagram that shows the external forces acting on P. [2]
- (ii) Find the tension in the string. [4]
- (iii) Find the magnitude of the reaction of the wall on P. [3]

- 4** At time $t = 0$ seconds, a freight train passes through a station with a constant velocity of 15 m s^{-1}
 Four minutes later, an express train sets off from rest from the same station. It accelerates at 2 m s^{-2} in the same direction of travel as the freight train.
 The express train accelerates to a maximum velocity of 40 m s^{-1} and then maintains this velocity.
- (i)** Sketch a velocity–time graph for each of the two trains. Do this on the same diagram. [3]
- (ii)** Find the value of t when the express train reaches its maximum velocity. [3]
- (iii)** Find the value of t when the express train overtakes the freight train.
 [You may assume that the express train reaches its maximum velocity before it overtakes the freight train.] [5]
- 5** At time $t = 0$ seconds, a particle P passes through a fixed point O with velocity 4 m s^{-1}
 P moves along a straight horizontal line so that its acceleration $a \text{ m s}^{-2}$ at any time t is given by
- $$a = 6t - 8$$
- (i)** Find the velocity of P at $t = 4$ [4]
- (ii)** Find the displacement of P from O when $a = 10$ [5]

6 In this question take $g = 10 \text{ m s}^{-2}$

Fig. 3 below shows two boxes X and Y. The boxes are connected to either end of a light inextensible string that passes over a smooth fixed pulley, P.

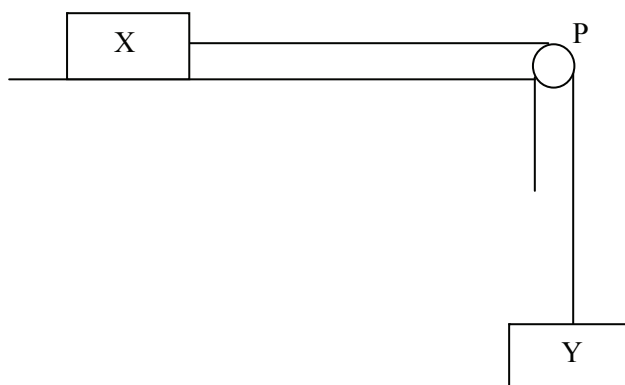


Fig. 3

X has mass $2m$ kg and is on a horizontal surface.

Y has mass $3m$ kg and hangs freely.

X is being pulled along the surface by a constant horizontal force F newtons.

A constant force of mg newtons resists the motion of X.

Y is rising vertically.

(i) Draw a diagram that shows the external forces acting on the boxes. [2]

(ii) Find, in terms of F and m , an expression for the acceleration of the system. [4]

(iii) Find, in terms of F and m , an expression for the tension in the string. [2]

(iv) Find, in terms of F and m , an expression for the resultant force acting on the pulley. [4]

- 7 A man needs to do some repairs to the flat roof of his garage.
To get onto the roof, he places a uniform ladder AB against the roof of the garage.
This is shown in **Fig. 4** below.

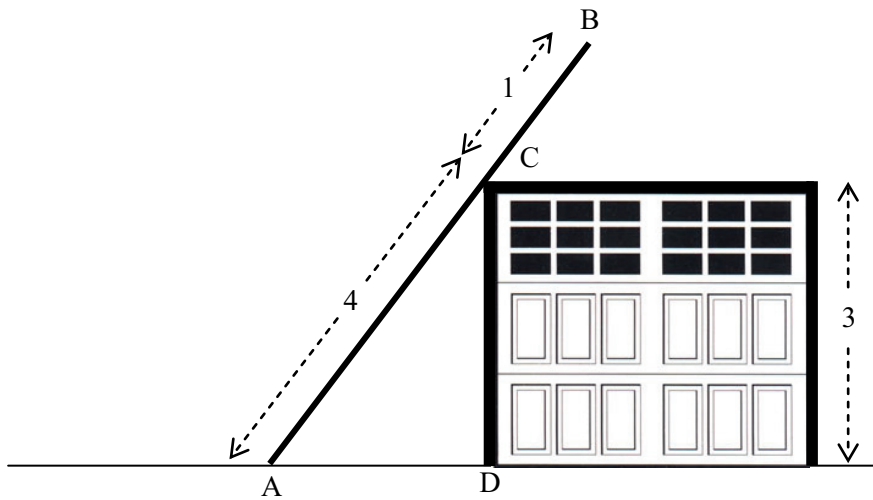


Fig. 4

The ladder is 5 m long and has mass 10 kg.
The ladder rests against the smooth edge of the roof at the point C, where $AC = 4$ m.
The wall CD is vertical and 3 m high.
End A is on rough horizontal ground.

- (i) Draw a diagram that shows the forces acting on the ladder. [2]
- (ii) Find the magnitude of the reaction at C. [5]
- (iii) Find the magnitude of the normal reaction at A. [3]

8 A parcel of mass 8 kg is placed on a rough slope inclined at 30° to the horizontal. The coefficient of friction between the parcel and the slope is 0.2. A horizontal force X newtons acts on the parcel causing it to accelerate up the slope at 1.2 m s^{-2} .

(i) Draw a diagram that shows the external forces acting on the parcel. [2]

(ii) Find the magnitude of X . [7]

THIS IS THE END OF THE QUESTION PAPER

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