



Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
January 2013

Mathematics

Assessment Unit M1

assessing

Module M1: Mechanics 1

[AMM11]



WEDNESDAY 30 JANUARY, MORNING

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 $g = 9.8 \text{ ms}^{-2}$, unless specified otherwise.

A copy of the **Mathematical Formulae and Tables booklet** is provided.



Answer all seven 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 four forces acting along the sides of a trapezium ABCD in which AD is parallel to BC.

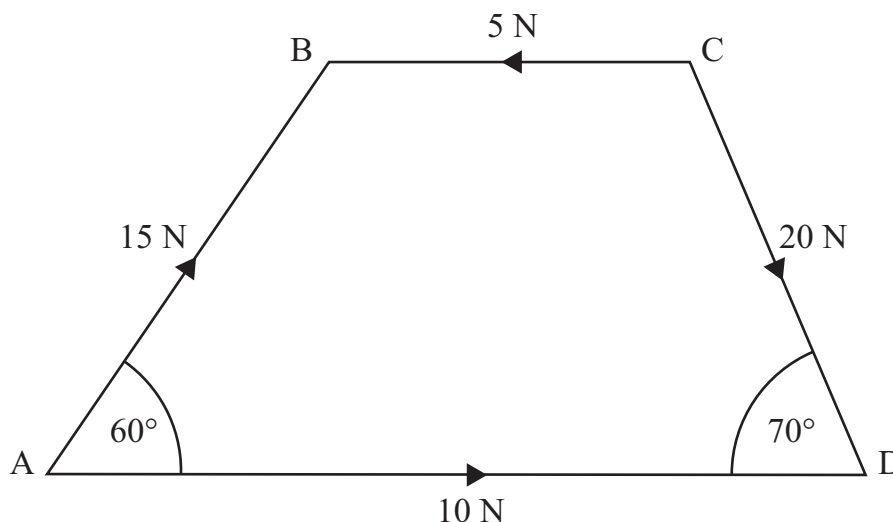


Fig. 1

Find the magnitude of the resultant of these forces.

[8]

- 2** A train is travelling along a straight horizontal track with an acceleration of 0.1 ms^{-2} .
When the train passes a point A its velocity is 5 ms^{-1} .
When it passes a point B its velocity is 11 ms^{-1} .

(i) Find the distance from A to B.

[3]

The mass of the train is 40 000 kg and the resistance to its motion is 24 000 N.

(ii) Find the tractive force produced by the train's engine.

[3]

- 3 A particle P of mass $2m$ kilograms is travelling in a straight line with speed $3u \text{ m s}^{-1}$ on a smooth horizontal surface.
 A second particle Q of mass $6m$ kilograms is travelling in the opposite direction with speed $4u \text{ m s}^{-1}$ along the same straight line.
 P and Q collide and after the collision P rebounds with speed $3u \text{ m s}^{-1}$

(i) Find, in terms of u , the velocity of Q after the collision. [5]

(ii) Find, in terms of m and u , the impulse exerted by P on Q. [3]

- 4 A block A of mass 6 kg is held at rest on a smooth plane inclined at an angle θ to the horizontal where $\sin \theta = \frac{1}{3}$
 It is attached to a light inextensible string which passes over a fixed smooth light pulley to a block B of mass $m \text{ kg}$ which hangs freely in equilibrium as shown in **Fig. 2** below.

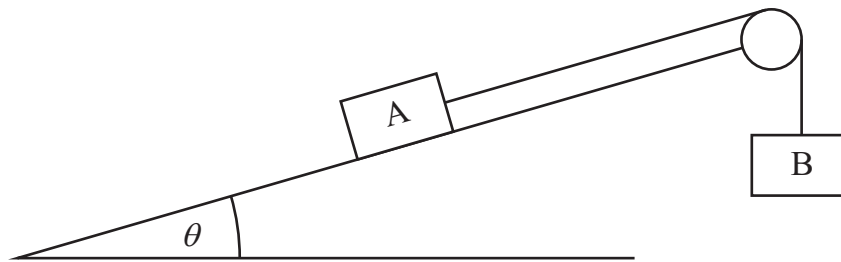


Fig. 2

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

(ii) Find the value of m . [5]

Block B is now replaced by a block C of mass 4 kg .
 The system is released from rest and A moves up the plane.

(iii) Find the acceleration of the system. [5]

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

$$a = 24 - 6t$$

When $t = 0$, P passes through a point X, which has displacement 10 m from a fixed origin O, with velocity -36 m s^{-1}

(i) Find an expression for the velocity of P at any time t . [4]

(ii) Find the maximum velocity of P. [4]

(iii) Find the **distance** of P from O when its velocity is a maximum. [4]

- 6 At time $t = 0$ seconds Peter is driving along a straight horizontal road with constant speed 14 m s^{-1} and passes a road sign S. Richard drives his car along the same road in the same direction with uniform deceleration 1 m s^{-2} . When $t = 4$, Richard passes S with speed 25 m s^{-1}

(i) Sketch a velocity–time diagram showing the motion of the two cars. [3]

Richard overtakes Peter at a point X.
At a later time Peter overtakes Richard at a point Y.

Find:

(ii) the values of t at X and Y; [8]

(iii) the distance from X to Y. [3]

- 7 **Fig. 3** below shows a uniform rod AB with the end B resting against a rough vertical wall. The coefficient of friction between the wall and the rod is μ . The rod is 2 m long and has mass 3 kg. The rod is kept in limiting equilibrium by a light inextensible string, one end of which is attached to the end A of the rod and the other to a point C on the wall 2 m above B. The angle $ABC = 120^\circ$. The end B of the rod is about to slip down the wall.

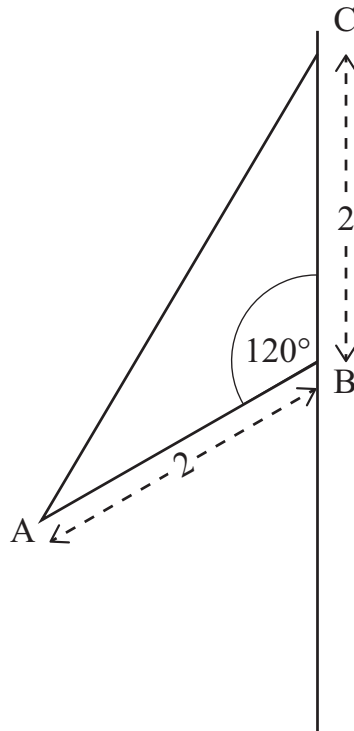


Fig. 3

- (i) Draw a diagram showing all the external forces acting on the rod. [2]
- (ii) By taking moments about C, show that the normal reaction at B is approximately 12.7 N. [5]
- (iii) Find the value of μ . [8]

THIS IS THE END OF THE QUESTION PAPER

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