Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
January 2013

Mathematics

Assessment Unit M1

assessing

Module M1: Mechanics 1

[AMM11]

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 $g = 9.8\,m\,s^{-2}$, 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.

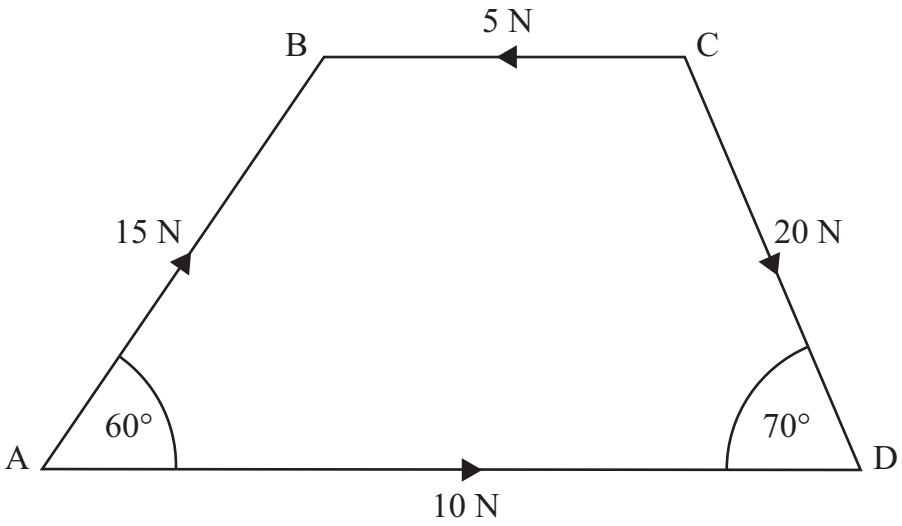

Fig. 1

Find the magnitude of the resultant of these forces. [8]

2 A train is travelling along a straight horizontal track with an acceleration of $0.1\,m\,s^{-2}$
When the train passes a point A its velocity is $5\,m\,s^{-1}$
When it passes a point B its velocity is $11\,m\,s^{-1}$

(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 $3u$ m s^{-1} on a smooth horizontal surface.
A second particle Q of mass $6m$ kilograms is travelling in the opposite direction with speed $4u$ m s^{-1} along the same straight line.
P and Q collide and after the collision P rebounds with speed $3u$ 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 kg which hangs freely in equilibrium as shown in **Fig. 2** below.

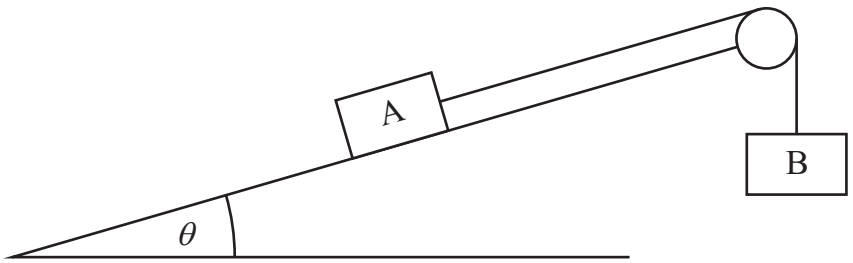

Fig. 2

(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 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°
The end B of the rod is about to slip down the wall.

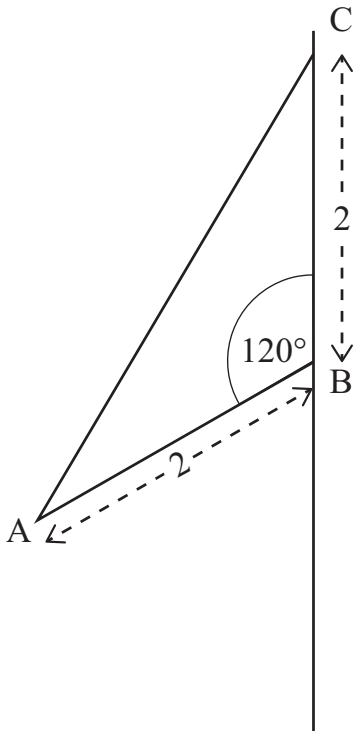

Fig. 3

(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