Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
January 2011

Mathematics

Assessment Unit M1

assessing

Module M1: Mechanics 1

[AMM11]

AMM11

WEDNESDAY 19 JANUARY, 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 $g = 9.8\,m\,s^{-2}$, 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 parallelogram ABCD.

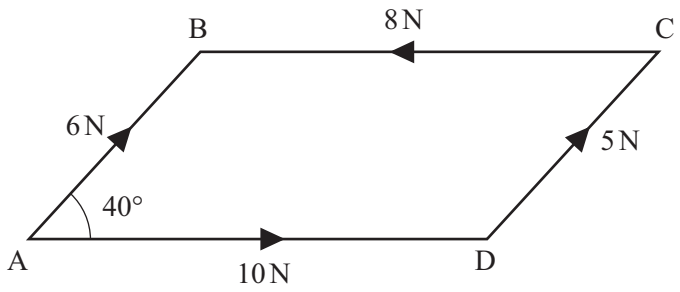

Fig. 1

(i) Find the magnitude of the resultant of these forces. [7]

(ii) Find the angle this resultant makes with the side AD. [2]

2 From a point P, a rocket is fired vertically upwards with an initial speed of u m s^{-1}.
P is 20 m above horizontal ground.
The rocket reaches a maximum height of 64.1 m above the ground.

(i) Find u. [4]

(ii) Find the total time it takes for the rocket to reach the ground. [5]

3 **Fig. 2** below shows two blocks of mass $2m$ kg and $4m$ kg connected by a light inextensible string which passes over a smooth fixed pulley.

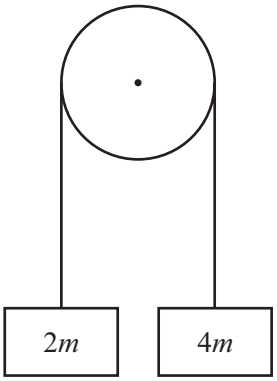

Fig. 2

The system is released from rest.

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

(ii) Find the acceleration of the blocks. [5]

4 **Take g = 10 m s^{-2} in this question**.

A pile driver of mass 150 kg is used to drive a pile of mass 75 kg into the ground. The pile driver is released from rest, 11.25 m vertically above the pile.

(i) Show that the speed with which the pile driver hits the pile is 15 m s^{-1} [3]

(ii) Find the common speed of the pile and pile driver after the impact. [4]

The pile driver and pile come to rest 0.1 s after the impact.

(iii) Find the resistance exerted by the ground. [5]

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

$$v = 16t - 3t^2$$

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

When $t = 0$ the particle's displacement from a fixed origin, O, is $-10\,\text{m}$.

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

(iii) Find the distance travelled by the particle in the first second of its motion. [2]

(iv) Find the maximum velocity of the particle. [6]

6 **Fig. 3** below shows a skier of mass 78 kg being pulled up a smooth slope by a rope.
The slope is inclined at an angle of 20° to the horizontal.
The rope is inclined at an angle of 60° to the slope.

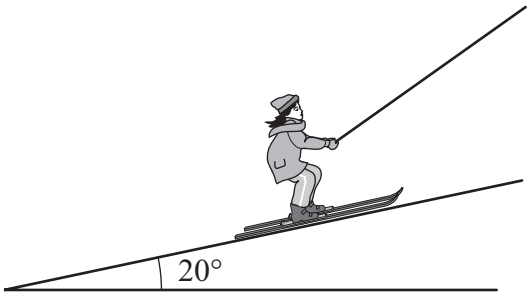

Fig. 3

Model the skier as a particle.

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

The skier is moving at a constant speed of $2\,m\,s^{-1}$

(ii) Find the tension in the rope. [4]

When the skier is 26 m from the bottom of the slope, she lets go of the rope.

(iii) Find the speed of the skier when she reaches the bottom of the slope. [5]

7 **Fig. 4** below shows a **non-uniform** ladder, AB, resting in equilibrium against the top of a smooth vertical wall.
The ladder touches the wall at a point C.
The end A rests on rough horizontal ground.
The coefficient of friction between the ladder and the ground is μ.
The ladder makes an angle of 60° with the horizontal.

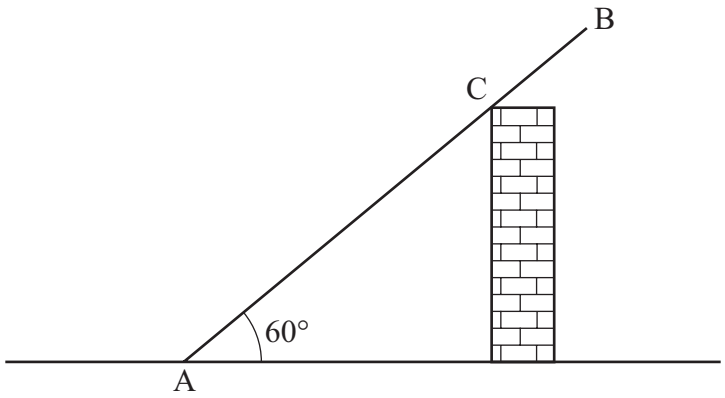

Fig. 4

The mass of the ladder is 10 kg.
AB = 8 m.
AC = 7 m.

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

The reaction between the ladder and the wall at C is 39.2 N.

(ii) By taking moments about A find the distance of the centre of mass of the ladder from A. [4]

(iii) Find μ. [6]

THIS IS THE END OF THE QUESTION PAPER