Rewarding Learning

ADVANCED SUBSIDIARY (AS)

General Certificate of Education

2016

Mathematics

Assessment Unit M1

assessing

Module M1: Mechanics 1

AMM11

[AMM11]

WEDNESDAY 25 MAY, 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 $g = 9.8\,\text{m}\,\text{s}^{-2}$, 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 A stone is thrown vertically downwards from the top of a cliff at a speed of 5 m s^{-1}
The top of the cliff is 250 m above horizontal ground.
If air resistance is ignored,

(i) find the speed of the stone as it hits the ground, [2]

(ii) find the time taken for the stone to fall to the ground. [2]

The mass of the stone is 0.2 kg.
If air resistance is included as a constant force of magnitude 0.8 N,

(iii) find the acceleration of the stone. [3]

2 **Fig. 1** below shows the displacement-time graph of a cyclist's journey along a straight horizontal road.

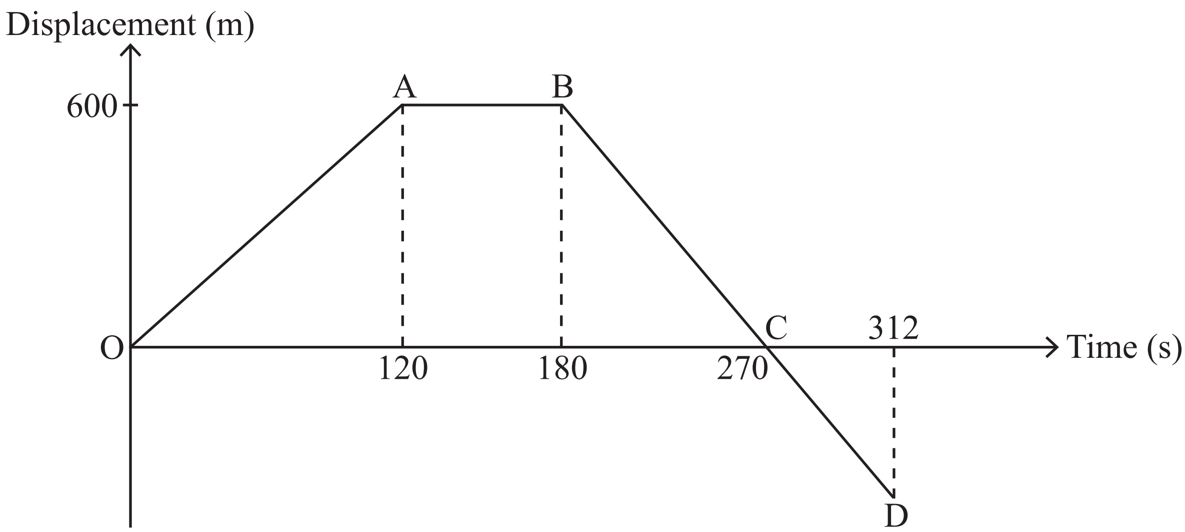

Fig. 1

Five points O, A, B, C and D are marked on the graph above corresponding to the cyclist's journey at 0, 120, 180, 270 and 312 seconds respectively.

(i) Find the velocity of the cyclist as he travels from O to A. [2]

The cyclist maintains a constant velocity as he travels from B to D.

(ii) Find the displacement of D from O. [4]

(iii) Find the cyclist's average speed for the complete journey. [3]

3 **Fig. 2** below shows a light fitting of mass 2 kg suspended by electric cables AF and FB. The ends A and B are fixed to a horizontal ceiling and a vertical wall respectively. The system is in equilibrium and lies in a vertical plane.

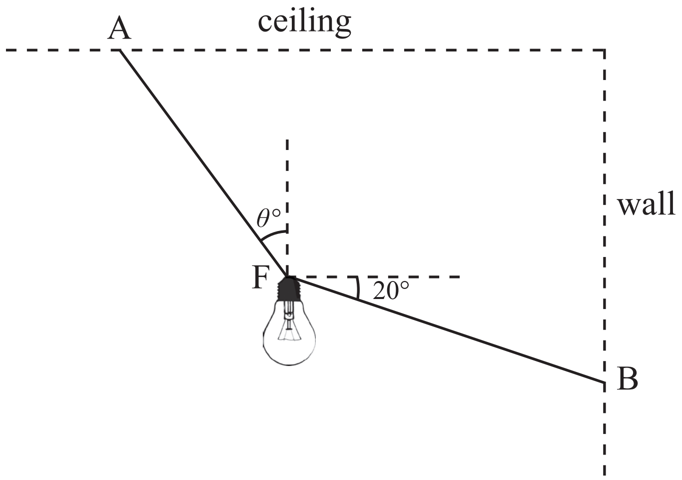

Fig. 2

The cable AF is inclined at an angle of $\theta°$ to the vertical and the tension in this cable is T N. The cable FB is inclined at an angle of 20° to the horizontal and the tension in this cable is 10 N.

Model the light fitting as a particle.

(i) State one modelling assumption you will make about the cables. [1]

(ii) Draw a diagram showing the external forces acting on the light fitting. [2]

(iii) Find T and θ. [8]

4 A particle P moves in a straight line so that its velocity v m s^{-1} at time t seconds, is given by

$$v = 0.6t^2 + kt + 12$$

where k is a constant.

The minimum velocity of P occurs at $t = 6$

(i) Show that $k = -7.2$ [4]

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

Initially, the displacement of the particle from a fixed point O is 0.5 m.

(iii) Find the total distance travelled by the particle between $t = 0$ and $t = 10$ [6]

5 Two particles are moving in the same direction along the same straight line on a smooth horizontal surface.
The particles A and B have masses km kg and m kg respectively, where k is a positive constant.
Initially, the velocities of A and B are 4 m s^{-1} and 2 m s^{-1} respectively, as shown in **Fig. 3** below.

Fig. 3

A collides with B.
After the collision, A moves in the same direction as before, but now with a velocity of 3 m s^{-1}

(i) Find an expression, in terms of k, for the velocity of B after the collision. [4]

(ii) Find an expression, in terms of k and m, for the impulse given to A by B. [3]

(iii) If B is now travelling at twice its original velocity, find the value of k. [2]

6 In this question, take g = 10 m s^{-2}

Fig. 4 below shows two boxes X and Y each of mass *m* kg.
The boxes are connected by a light inextensible string which passes over a light smooth fixed pulley P.
The system lies in a vertical plane.

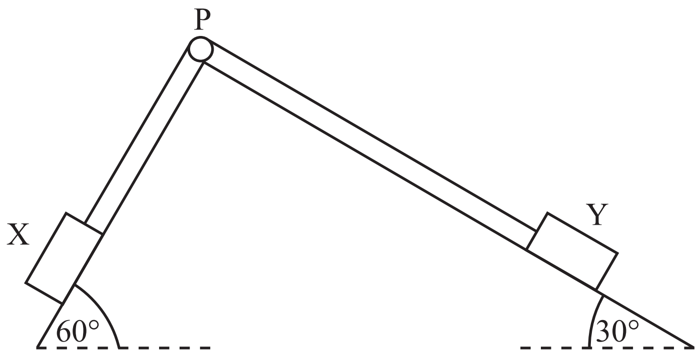

Fig. 4

X lies on a rough plane inclined at 60° to the horizontal.
The coefficient of friction between X and the plane is $\frac{1}{\sqrt{3}}$
Y lies on a smooth plane inclined at 30° to the horizontal.

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

The system is released from rest and box X starts to move down the plane.

(ii) Find the acceleration of the system. [8]

(iii) Find, in terms of *m*, the magnitude of the resultant force exerted by the string on the pulley. [4]

7 **Fig. 5** below shows a uniform ladder AB of length 2 m and mass 20 kg.
End A rests on rough horizontal ground.
End B leans against a smooth vertical wall.
The coefficient of friction between the ladder and the ground is 0.3
The ladder is inclined at 25° to the vertical.

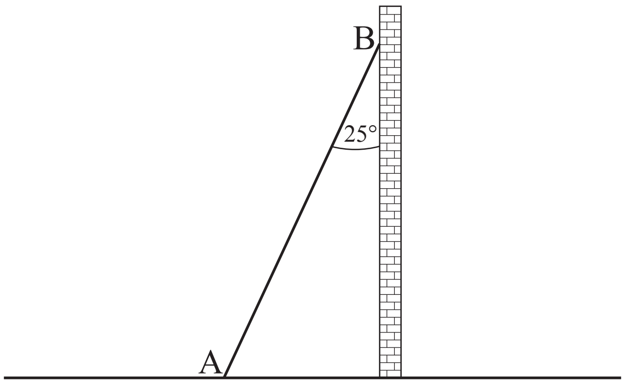

Fig. 5

Robert, of mass 70 kg, starts to climb the ladder from A.

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

(ii) Find how far up the ladder Robert can climb before the ladder starts to slip. [10]

THIS IS THE END OF THE QUESTION PAPER