



**General Certificate of Education
Advanced Subsidiary/Advanced**

980/01

**MATHEMATICS M1
Mechanics 1**

A.M. TUESDAY, 15 January 2008
(1½ hours)

ADDITIONAL MATERIALS

In addition to this examination paper, you will need:

- a 12 page answer book;
- a Formula Booklet;
- a calculator.

INSTRUCTIONS TO CANDIDATES

Answer **all** questions.

Take g as 9.8 ms^{-2} .

INFORMATION FOR CANDIDATES

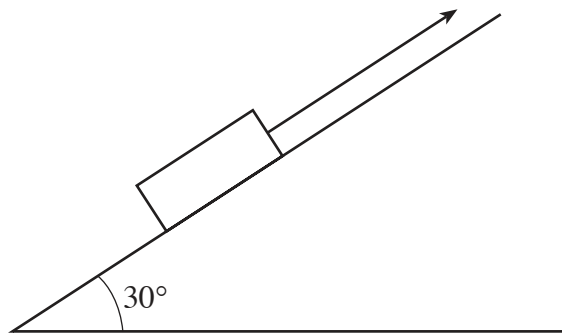
The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

1. A vehicle, moving with uniform acceleration along a straight horizontal road, has its speed measured at points A and B on the road. At point A , its speed is 12 ms^{-1} and at point B , its speed is 20 ms^{-1} . The distance AB is 1000 m .
 - (a) Show that the acceleration of the vehicle is 0.128 ms^{-2} . [3]
 - (b) Find the time taken for the vehicle to move from A to B . [3]
 - (c) Find the speed of the vehicle 25 s after passing A . [3]
 - (d) Calculate the distance from A of the vehicle 30 s after it passes A . [3]
 - (e) Sketch a velocity-time graph for the journey from A to B . [2]

2. A ball is dropped from rest from a height of 3.6 m above a horizontal floor. The coefficient of restitution between the ball and the floor is 0.3 . Calculate the speed of the ball immediately after it rebounds from the floor. [5]

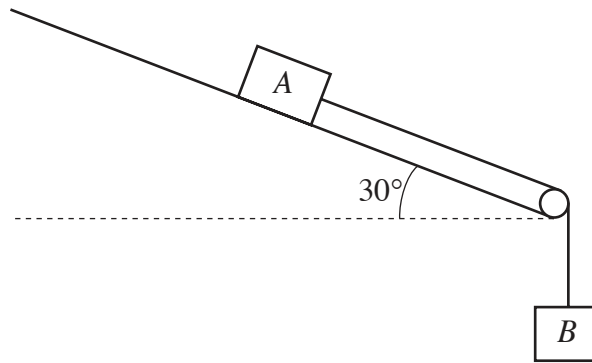
3. The diagram shows a sledge on a hill with a rope attached. The hill is modelled as a rough plane inclined at an angle of 30° to the horizontal and the rope is modelled as a light inextensible string parallel to a line of greatest slope of the plane. The sledge is modelled as a particle of mass 15 kg . The coefficient of friction between the sledge and hill is 0.2 .



When the tension of the rope is 12 N , the sledge slides **down** the hill. Calculate the magnitude of the acceleration of the sledge, giving your answer correct to one decimal place. [6]

4. A parcel is on the floor of a lift which is ascending with acceleration 0.8 ms^{-2} . The mass of the parcel is 20 kg and the mass of the lift is 700 kg .
 - (a) Calculate the tension in the lift cable. [3]
 - (b) Find the reaction of the floor of the lift on the parcel. [3]

5. Two toy trucks are moving in the same horizontal straight line in the same direction. Truck A, of mass 0.48 kg , is moving with speed 0.075 ms^{-1} and truck B, of mass 0.36 kg , is moving with speed 0.05 ms^{-1} . Truck A catches up with and collides directly with B. After the collision, A continues to move in its original direction and its speed is 0.06 ms^{-1} .
- (a) Find the speed of B after the collision. [3]
- (b) Calculate the coefficient of restitution between the trucks. [3]
- (c) Determine the impulse exerted by A on B. [2]
6. A light inextensible string connects object A, of mass 2 kg , to object B, of mass 3 kg . The diagram shows A on a smooth plane, inclined at an angle of 30° to the horizontal with the string passing over a smooth light pulley at the edge of the plane so that B hangs freely. Initially, A is held at rest with the string taut.



The system is released from rest. Find the magnitude of the acceleration of object A and the tension in the string. [7]

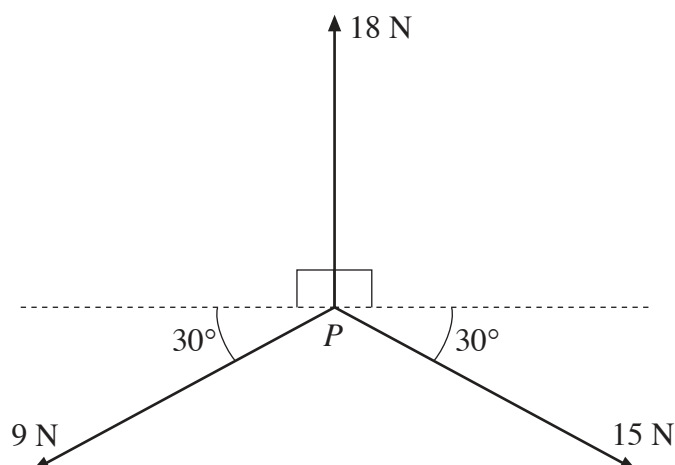
7. The diagram shows a uniform rod AB of length 3 m and mass 9 kg , with a particle, of mass 2 kg , attached at A. The rod is resting horizontally in equilibrium on two smooth supports at points P and Q of the rod, where $AP = 1.2 \text{ m}$ and $AQ = 2.6 \text{ m}$.



- (a) Calculate the reactions at P and Q. [7]
- (b) When an additional particle, of mass 3 kg , is attached to the point R of the rod, the rod is on the point of turning about P. Calculate the distance AR. [3]

TURN OVER.

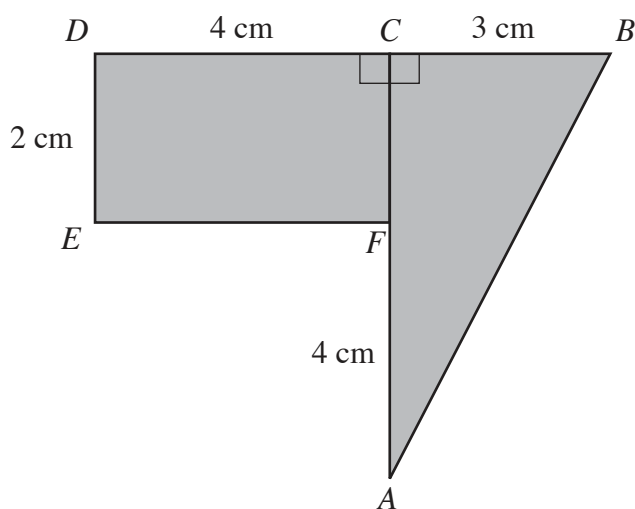
8. Three horizontal forces, with magnitudes 18 N, 15 N and 9 N, act at a point P in directions as shown in the diagram.



Calculate the magnitude and direction of the resultant of the forces.

[8]

9. The diagram shows a uniform lamina $ABCDEF$. The lamina consists of a triangle ABC right-angled at C and a rectangle $CDEF$. Measurements are shown in the diagram.



- (a) Find the distances of the centre of mass of the lamina from DE and DB . [9]
- (b) The lamina is suspended freely from D and hangs in equilibrium. Determine the angle DB makes with the vertical. [2]