WELSH JOINT EDUCATION COMMITTEE CYD-BWYLLGOR ADDYSG CYMRU

General Certificate of Education **Tystysgrif Addysg Gyffredinol**

Advanced Level/Advanced Subsidiary **Safon Uwch/Uwch Gyfrannol**

MATHEMATICS M1

Mechanics

Specimen Paper 2005/2006

($1\frac{1}{2}$ hours)

INSTRUCTIONS TO CANDIDATES

Answer **all** questions.

Take g as 9·8 ms^{-2}.

INFORMATION FOR CANDIDATES

A calculator may be used for this paper.

A formula booklet is available and may be used.

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 lift, of mass 600 kg, travels downward non-stop from the top of a building to the ground floor. It starts from rest and accelerates downwards with constant acceleration of 0·4 ms^{-2}, then moves at constant speed before decelerating to rest.

(a) Calculate the tension in the lift cable when the lift is accelerating. [3]

(b) Find the tension in the lift cable when the lift is moving at a constant speed. [1]

2. A car is moving at a constant speed of 20 ms^{-1} when it passes the point *A* on a straight horizontal road. As it passes point *A*, it accelerates at a constant rate until its speed reaches 25 ms^{-1} in 720 m. It then decelerates at a constant rate for 4·5 minutes before stopping at the point *B*.

(a) Calculate the time taken during acceleration. [3]

(b) Sketch a velocity-time graph for the car's journey between *A* and *B*. [3]

(c) Find the distance between *A* and *B*. [3]

3. A ball is dropped from a height *h* m and hits the horizontal ground with speed 14 ms^{-1}.

(a) Calculate the value of *h*. [3]

(b) Find the time taken for the ball to reach the ground. [3]

The coefficient of restitution between the ball and the ground is 0·6.

(c) Determine the speed with which the ball rebounds. [2]

4. A body *A*, of mass 6 kg, moving with speed 10 ms^{-1} on a smooth horizontal floor, collides directly with another body *B*, of mass 9 kg, moving with speed 6 ms^{-1} in the same direction as *A*. After the collision, *A* moves with speed 7 ms^{-1} in its original direction of motion and *B* moves with speed 8 ms^{-1}.

(a) Calculate the coefficient of restitution between the bodies. [3]

Body *B* then collides with another body *C*, moving with speed 4 ms^{-1} on the same straight line towards *B*. After collision, the two bodies, *B* and *C*, move as one with speed 5 ms^{-1} in the original direction of motion of *B*.

(b) Determine the mass of *C*. [3]

5. Two particles *A* and *B*, of masses 4 kg and 3 kg respectively, are connected by a light inextensible string passing over a smooth pulley fixed at the edge of a table. Initially, *A* is held at rest on the table and *B* is hanging freely with the string taut. The system is then released.

(a) Given that the table is smooth, calculate the magnitude of the acceleration of the particles, and the tension in the string. [7]

(b) Given that the table is rough and that the particles remain at rest after the system is released, determine the range of possible values for the coefficient of friction between the table and particle *A*. [5]

6. The diagram shows a uniform plank *AD*, of length 1·6 m and mass 5 kg, resting horizontally on two supports at *B* and *C*, where *AB* = 0·4 m and *CD* = 0·2 m. The reactions on the plank at the supports *B* and *C* are denoted by *P* and *Q* respectively.

(a) Find the magnitudes of the reactions at the supports. [6]

(b) Determine the greatest weight that can be placed at *D* without the plank tilting. [4]

7. A body of mass 12 kg is moving on a line of greatest slope of a rough plane inclined at an angle of 20° to the horizontal, under the action of a constant force of magnitude 150 N acting up the slope. The coefficient of friction between the body and the slope is 0·6.

(a) Calculate the magnitude of the acceleration of the body. [8]

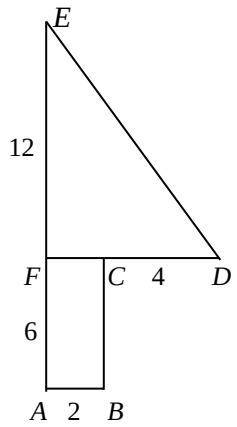
(b) State **one** modelling assumption you have made in your solution. [1]

8. A ball of mass 0·25 kg, travelling along the horizontal ground is moving with speed 5 ms^{-1} when it is kicked by a boy. The kick exerts an impulse of 2 Ns on the ball, in a direction opposite to the original direction of motion of the ball.

(a) Find the speed and direction of motion of the ball immediately after being kicked. [3]

(b) The ball is in contact with the boy's foot for 0·2 s. Assuming that the force exerted by the boy throughout the kick is constant, find the magnitude of this force. [3]

9. The diagram shows a uniform lamina *ABCDEF* consisting of a triangle *DEF* and a rectangle *ABCF*. Dimensions, in centimetres, are also shown in the diagram.



(a) Find the distances of the centre of mass of the lamina *ABCDEF* from *AE* and *AB*. [8]

(b) The lamina is freely suspended from *E* and hangs in equilibrium. Find the angle *AE* makes with the vertical. [3]