



GCE AS/A level

0980/01

MATHEMATICS – M1
Mechanics

A.M. THURSDAY, 6 June 2013

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

Use black ink or black ball-point pen.

Answer **all** questions.

Take g as 9.8 ms^{-2} .

Sufficient working must be shown to demonstrate the **mathematical** method employed.

INFORMATION FOR CANDIDATES

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

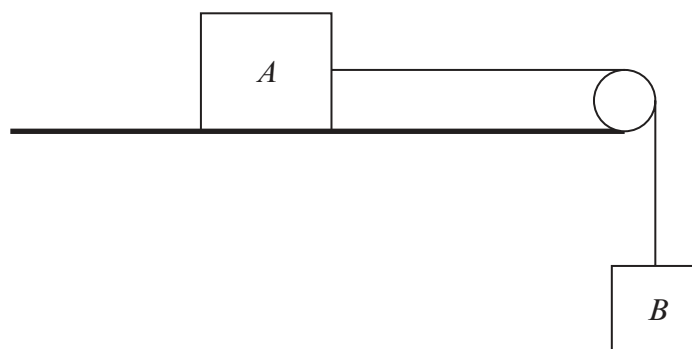
You are reminded of the necessity for good English and orderly presentation in your answers.

1. A vehicle moves along a straight horizontal road. At time $t = 0$ s, the vehicle passes a point A and is moving with a speed of 20 ms^{-1} . It continues with this constant speed of 20 ms^{-1} for 8 s. The vehicle then slows down with uniform deceleration for 10 s so that at time $t = 18$ s, the speed of the vehicle is 6 ms^{-1} . This speed is maintained until the vehicle reaches the point B at time $t = 40$ s.
 - (a) Sketch a velocity-time graph for the motion of the vehicle between A and B . [3]
 - (b) Find the magnitude of the deceleration between $t = 8$ and $t = 18$. [3]
 - (c) Calculate the distance AB . [3]

2. A person of mass 64 kg is standing in a lift which is of mass M kg. When the lift is accelerating downwards at a constant rate of 0.425 ms^{-2} , the tension in the lift cable is 7500 N.
 - (a) Calculate the value of M . [3]
 - (b) Find the reaction between the person and the floor of the lift. [3]

3. An object is projected vertically upwards with speed $u \text{ ms}^{-1}$ from a point A which is 2.8 m above horizontal ground. The object reaches its greatest height of 18.225 m above A before falling to the ground.
 - (a) Show that the value of u is 18.9. [3]
 - (b) Find the time between the object being projected and the object hitting the ground. [4]

4. The diagram shows two bodies A and B , of mass 9 kg and 5 kg respectively, connected by a light inextensible string passing over a smooth light pulley fixed at the edge of a **rough** horizontal table. The heavier body A lies on the table and the lighter body B hangs freely below the pulley.



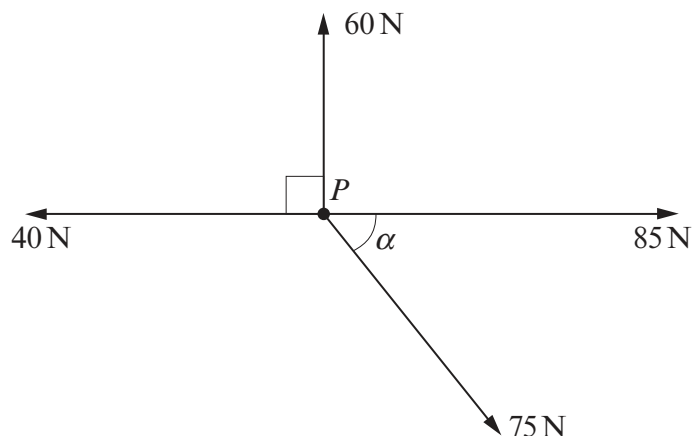
Initially, the system is held at rest with the string taut. The system is then released.

- (a) Given that the magnitude of the acceleration of the bodies is 1.61 ms^{-2} , calculate the tension in the string and the coefficient of friction between A and the table. [8]
- (b) Given that the coefficient of friction is 0.6, determine whether the bodies will move or remain at rest and evaluate the tension in the string. [3]

5. The diagram shows a uniform plank AB of mass 12 kg and length 2 m . The plank rests horizontally in equilibrium on two supports at C and at D , where $AC = 0.8\text{ m}$ and $AD = x\text{ m}$.



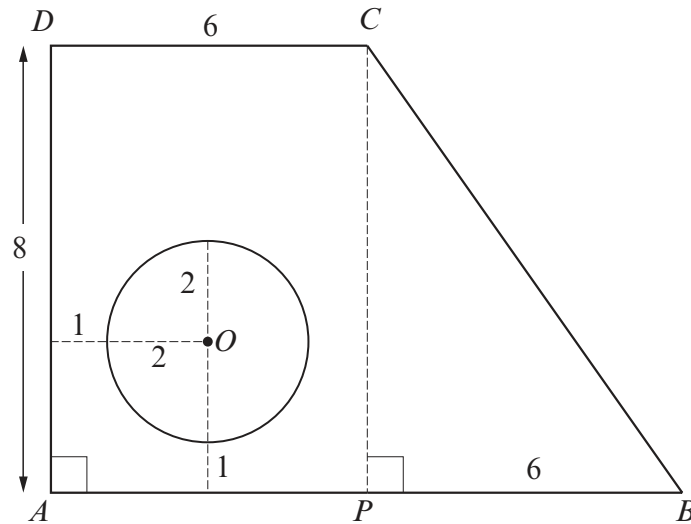
- (a) The reaction of the support on the plank at D has magnitude 84 N .
- Determine the reaction of the support on the plank at C .
 - Calculate the value of x . [7]
- (b) A rock of mass $M\text{ kg}$ is placed at A so that the plank is on the point of tilting about C . Calculate the value of M . [3]
6. A particle P , of mass 2 kg , is moving with speed $u\text{ ms}^{-1}$ in a straight line on a smooth horizontal surface. The particle P collides directly with another particle Q , of mass 5 kg , which is at rest on the surface. Immediately after the collision, P moves with speed 2 ms^{-1} in a direction opposite to the original direction of motion, and the speed of Q is 3 ms^{-1} .
- Find the value of u . [3]
 - Determine the coefficient of restitution between P and Q . [3]
 - Calculate the magnitude of the impulse exerted by P on Q . [2]
 - After the collision between P and Q , particle Q strikes a vertical wall which is perpendicular to its direction of motion. The coefficient of restitution between Q and the wall is 0.25 . Calculate the speed with which Q rebounds from the wall. [2]
7. Four coplanar horizontal forces of magnitude 60 N , 85 N , 75 N and 40 N act on a particle P , of mass 5 kg , in the directions shown in the diagram, where $\tan \alpha = \frac{3}{4}$.



- Calculate the magnitude of the resultant force and determine the angle it makes with the 85 N force. [9]
- Deduce the magnitude of the acceleration of the particle P . [2]

TURN OVER

8. The diagram shows a uniform lamina in the form of a trapezium $ABCD$ with a circular hole, of radius 2 cm, removed. The angle $\hat{DAB}$ is 90° . The dimensions, in cm, are shown in the diagram. The centre O of the circular hole is 3 cm from AD and 3 cm from AB .



- (a) Find the distances of the centre of mass of the lamina from AD and AB . [10]
- (b) When the lamina is freely suspended from a point Q on AD , it hangs in equilibrium with AB vertical. Write down the distance of Q from A . [1]