



GCE AS/A level

0980/01

MATHEMATICS – M1
Mechanics

P.M. FRIDAY, 25 January 2013

1½ hours

0980
010001

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.

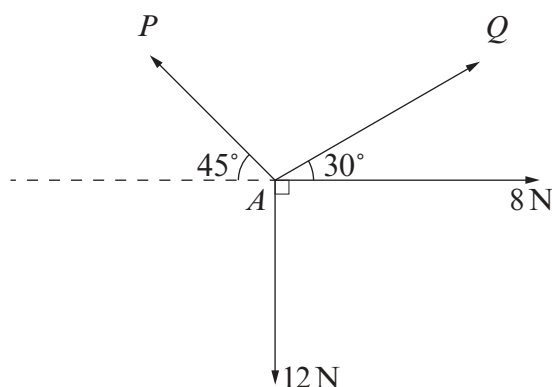
INFORMATION FOR CANDIDATES

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 car moves with constant acceleration along a straight horizontal road. It passes the point O with speed 12 ms^{-1} . It then passes point A , 4 seconds later, with speed 32 ms^{-1} .
- (a) Show that the acceleration of the car is 5 ms^{-2} . [3]
- (b) Determine the distance OA . [3]
- (c) The point M is the midpoint of OA . Calculate the speed of the car as it passes M . Give your answer correct to one decimal place. [3]
2. (a) Two particles A and B lie at rest on a smooth horizontal surface. Particle A has mass 3 kg and particle B has mass 7 kg . Particle A is projected with speed 4 ms^{-1} towards particle B and collides directly with it. When the particles collide, they coalesce to form one particle.
- (i) Write down the coefficient of restitution between the particles.
- (ii) Determine the speed of the combined particle after the collision. [4]
- (b) Another particle of mass 6 kg travelling with speed 5 ms^{-1} collides directly with a vertical wall and rebounds. The coefficient of restitution between the particle and the wall is 0.25 .
- (i) Calculate the speed of the particle after the collision with the wall.
- (ii) Find the impulse exerted by the wall on the particle. State your units clearly. [5]
3. A particle is projected vertically upwards with an initial speed of 15 ms^{-1} from a point A , which is 1.2 m above horizontal ground.
- (a) Determine the time taken for the particle to reach the ground. Give your answer correct to one decimal place. [4]
- (b) Suppose a heavier particle is projected vertically upwards from the same point A and with the same initial speed of 15 ms^{-1} . Would the time taken for the particle to reach the ground be greater, the same, or less than your answer in (a)? Give a reason for your answer. [1]

4. The diagram shows four forces acting at a point A in a horizontal plane.



Given that the forces are in equilibrium, calculate the value of P and the value of Q . Give your answers correct to one decimal place. [7]

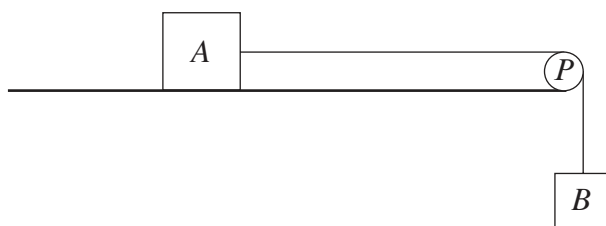
5. An object of mass 75 kg lies on a rough plane, which is inclined at an angle of 25° to the horizontal. The coefficient of friction between the object and the plane is 0.3 . A force of magnitude $T\text{ N}$ acts on the object in a direction parallel to a line of greatest slope of the plane.
- (a) Given that the object is just prevented from sliding down the plane, calculate the value of T . [6]
- (b) Given that $T = 0$, find the magnitude of the acceleration of the object. [3]
6. A parcel of mass 25 kg is on the floor of a lift, which is descending with an acceleration of $a\text{ ms}^{-2}$. The mass of the lift is 775 kg .
- (a) Given that the tension in the lift cable is 6500 N , calculate the value of a . [3]
- (b) Find the magnitude of the reaction of the floor of the lift on the parcel. [3]

TURN OVER

7. A uniform beam AB , of length 6 m, rests in a horizontal position on two smooth supports at C and D , where $AC = 1$ m and $BD = 1.2$ m, as shown in the diagram.

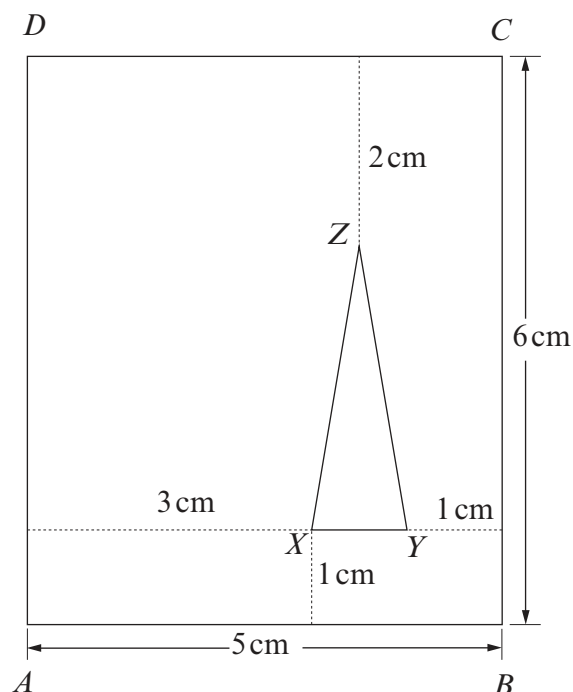


- (a) When a vertical force of magnitude 1800 N is applied upwards to the beam at the end A , the beam is about to tilt about the support at D . Determine the weight of the beam. [5]
- (b) The vertical force is now removed so that the beam is resting in equilibrium on the two supports. Calculate the magnitude of the reaction of each of the supports at C and D on the beam. [5]
8. The diagram shows a body A , of mass 5 kg, lying on a smooth horizontal table. It is connected to another body B , of mass 9 kg, by a light inextensible string, which passes over a smooth light pulley P fixed at the edge of the table so that B hangs freely.



Initially, the system is held at rest with the string taut. A horizontal force of magnitude 126 N is then applied to A in the direction PA so that B is raised. Find the magnitude of the acceleration of A and the tension in the string. [7]

9. The diagram shows a lamina, made of uniform material, consisting of a rectangle $ABCD$ with triangle XYZ removed. Triangle XYZ is isosceles with $XZ = YZ$ and XY parallel to AB . Dimensions are as shown in the diagram.



- (a) Calculate the distances of the centre of mass of the lamina from AD and AB . [9]
- (b) The lamina is freely suspended from A and hangs in equilibrium. Calculate the angle that AB makes with the vertical. [3]
- (c) When the lamina is suspended freely from a point P on DC , it hangs with AD vertical. Write down the length of DP . [1]